consulting engineer

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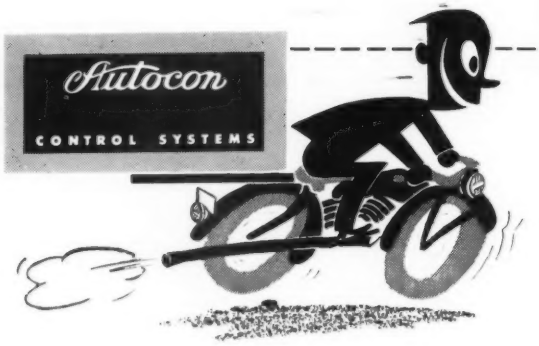
The Public Must Understand

HARRY R. WESTCOTT, president of Westcott and Mapes—a respected New England architectural and engineering firm located in New Haven, Conn.—has just taken on the biggest task in his many years of extra-curricular work serving his profession. He is the square-jawed, quiet-spoken man the American Society of Mechanical Engineers has chosen to head

—Continued on page 6



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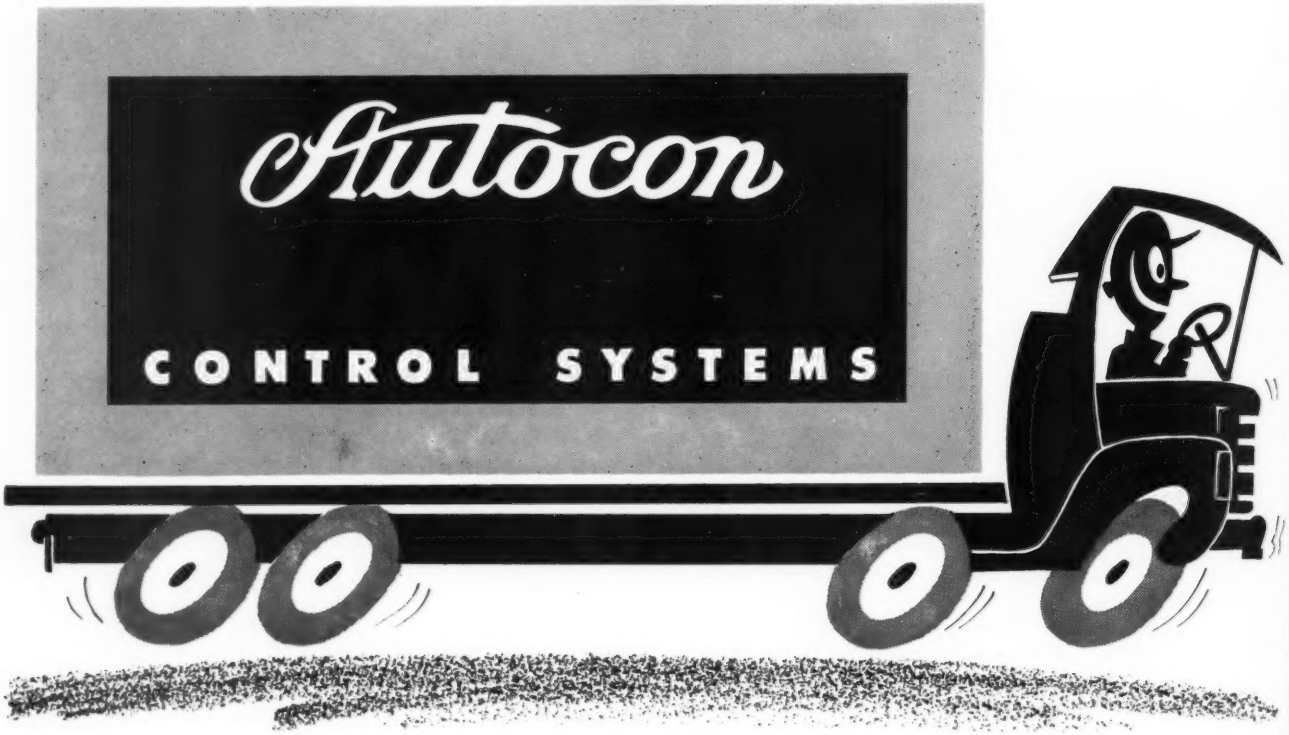

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JULY 1954

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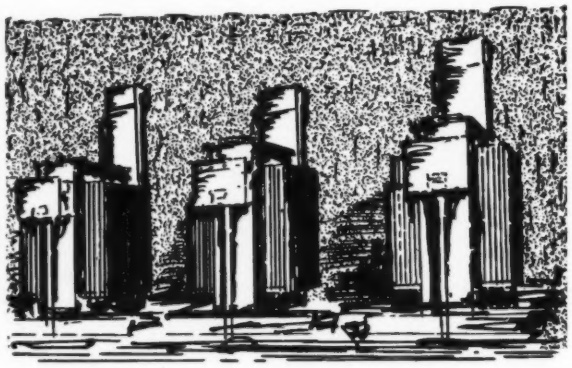
Professional Practice of Consulting

—Starts on Front Cover

its newly formed Committee on the Professional Practice of Consulting Engineering. The great scope of this committee's objectives is well defined by the items listed for discussion in the agenda for one of its recent meetings: securing the interest and support of all ASME members engaged in the professional practice of consulting engineering, enhancing the standards of the professional services performed by consulting engineers, securing the collaboration of other engineering societies in the ASME Committee's work, developing cooperation between consulting engineers, preparation of a manual of contractual relations for performing consulting engineering services, and arranging for sessions on the professional practice of consulting engineering at annual ASME conventions.

The assignment to head this committee comes to this shrewd, Massachusetts-born engineer as part of a movement planned to be made nationwide and to include all sectors of the engineering profession. Of deep concern to him are the challenges facing today's consultants: the general lack of public understanding of the consultant's part in the growth and development of our country, the matter of standards of performance by consultants, and the concurrent need of the consultant's acceptance as a truly professional man under conditions which will assure the highest professional performance.



Performance Standards

Westcott leaves no doubt but that he intends to approach these challenges patiently, in an unhurried fashion, and with the full realization that they are complex problems requiring painstaking assessment of the facts. He shares his committee's realization that great efforts must be made to define the role of the engineer in society and to provide better standards of performance for present and future engineers. His philosophy is refreshing in these days when engineers have been all too inclined to subordinate their thinking to the preoccupations of the moment or to the engineering tasks to which they are committed.

He has no pat, ready-made answers at this stage of the game. He has instead, a general readiness to fight not only for the professional status of the engineer but for achieving better standards through training, state licensing, and codification—as already practiced in medicine and law. At the very time when unionization seems to threaten the profession, and some questionable business methods threaten to overwhelm it, Westcott intends to emphasize "not the engineer but the thing he is doing."

There is more in his view of the job than the traditional New Englander's modesty. In his quiet offices overlooking the New Haven Green, he reminisces about a hard-working young farm boy who drove to a near-by city daily each summer with a load of vegetables for sale to storekeepers—with a quarter in his pocket saved for a dish of ice cream on completion of his rounds. He feels that the work he put in on the farm, and later earning his way through night school, Brown University, and Yale, was vital to his success, as it must have been to the success of many others. (He was later awarded an honorary degree from Stevens Institute.)

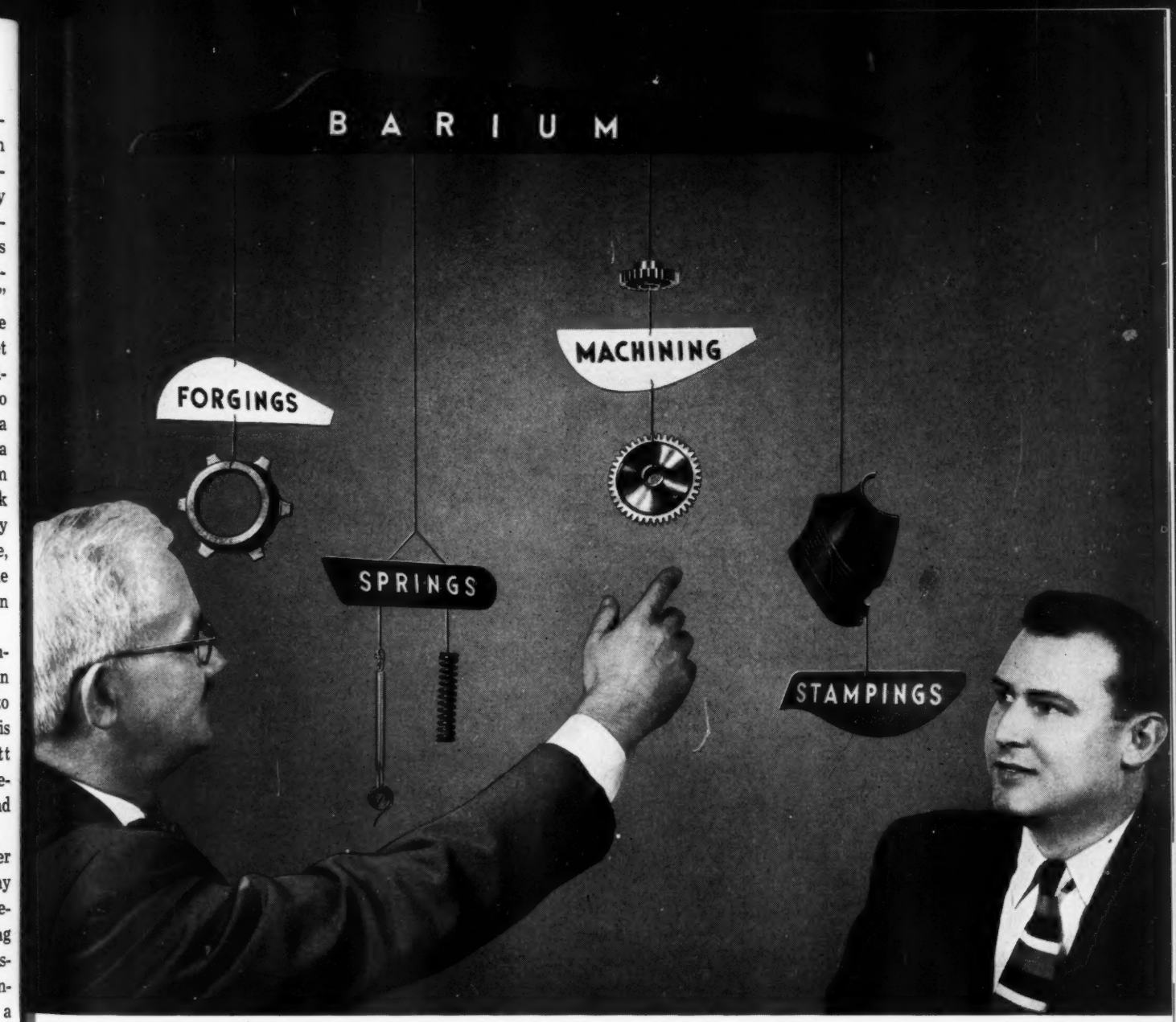
In the development of an engineer, another indefinable and possibly inborn quality is needed in addition to formal training. This is a willingness to accept responsibility. This is a quality Westcott thinks can be gained sometimes by working and striving to get ahead.

This then is the caliber of man and the philosophy that is leading a movement aimed at elevating the standards of professional practice for the consulting engineer — a branch of engineering that by its very nature strongly emphasizes self-reliance, individual initiative, and enterprise.

Westcott prefers to deal with the Committee program on a broad scale now, letting the final decisions come as further meetings of the 19-man committee may develop them. But he is presently outspoken about the action of some states in choosing engineering firms by competitive price bidding instead of through the more traditional practice of negotiation; he feels such practices work against the best interests of the client and profession.

Fit the Cloth

He feels strongly that the attempt in some states to legislate all corporate engineering firms out of existence is not practical. "We must have large engineering corporations to carry out the really big projects." He takes the realistic approach that "we must cut the garment to fit the cloth." Such is the manner in which Harry R. Westcott resolves the aims and ambitions of his Committee.



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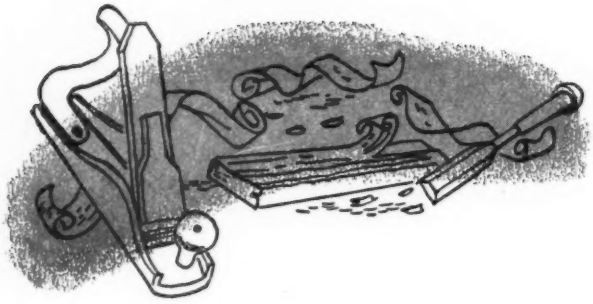

SCRAP & SHAVINGS

TWO BASIC PROBLEMS are facing the Engineers Joint Council. They know about one of them, and they may be beginning to understand the other. They know that some change must be made in their constitution so that there can be individual memberships. Currently, there are only eight members, eight of the largest and most important technical societies of this country. EJC is a federation of these societies, and it is, therefore, a society to which no individual engineer can belong. The individual engineer does nothing for EJC, and EJC responds in kind. This is a very real problem, for it has been pointed out many times (most recently by the Council of AIEE) that federations of societies have not worked in the past as a substitute for a unity organization, and there is little likelihood that they will work in the future. Men are disinclined to actively support organizations to which they do not belong.

Engineers Joint Council is trying to overcome this handicap. They have brought before the councils of the member societies a proposal which would permit them to have individual memberships. If passed this would mean that every engineer in the country who qualified for membership in one of the eight federated societies could become a member of EJC. While still in its formative stages, it would seem that the proposed plan would permit, but not require, members of the eight societies to join the central organization with personal memberships. An additional dues would be imposed, but it would be moderate — perhaps $3 to $5 per year. There would also be provision made for engineers to join who are not members of one of the eight technical societies but who have the necessary technical qualifications. Their dues, presumably, would be higher — maybe $5 to $10 per year.

Before EJC's constitution can be changed to permit such individual memberships, the eight federated societies must give their permission, first through their governing councils and then through actual vote of their memberships. That could take a long, long time, but, at least the idea has been presented. The Council of ASME has approved the idea, and ASCE seems willing to go along. AIEE's governing board has not voted yet, but it is well known that they favor a united organization composed of individual members, so they will no doubt vote affirmatively.

The AIME, the miners, are the ones who cannot, currently, see the light. Why they should be the backward group is hard to understand. It is high time they came up from the pits and took a look around. They should be able to see that the plan is much to their future advantage.

We hope EJC is successful in putting this plan through. If they are, it could mean the start of a real unity organization with a membership of over 200,000 engineers. That is what we need.

The second problem facing EJC is one of which they are only remotely aware and tend to ignore. Nobody knows who or what EJC is. It has, since its inception, lacked any good contact with engineers. We are now in the process of running a little survey to see just how many engineers are able to identify the initials, EJC. Some of the answers have been very interesting. We will publish a summary of the survey later.

To give an example of how obscure EJC is, we talked with one of the National Vice-Presidents of ASME (American Society of Mechanical Engineers) last week. He had just learned about EJC. He admitted that he had heard of them before, but he did not know what their purpose was or how they operated. He had looked upon it as some exclusive club of Founder Society Presidents and Past-Presidents. Then, at the June council meeting in Pittsburgh, he had heard Thomas A. Marshall, a former Secretary of EJC, tell about past work and plans for the future. The ASME Vice-President left the meeting enthused about the organization. He immediately asked that some arrangement be made to let Marshall go to his region and speak to the members at local section meetings.

It boils down to this: EJC now has the right idea, individual membership. It should not be too difficult to sell this idea to the councils of the affiliated societies. Next, it will be necessary to sell it to the members. That could be even easier, but until the members know what EJC stands for, it will be hard. EJC needs publicity. ▲▲

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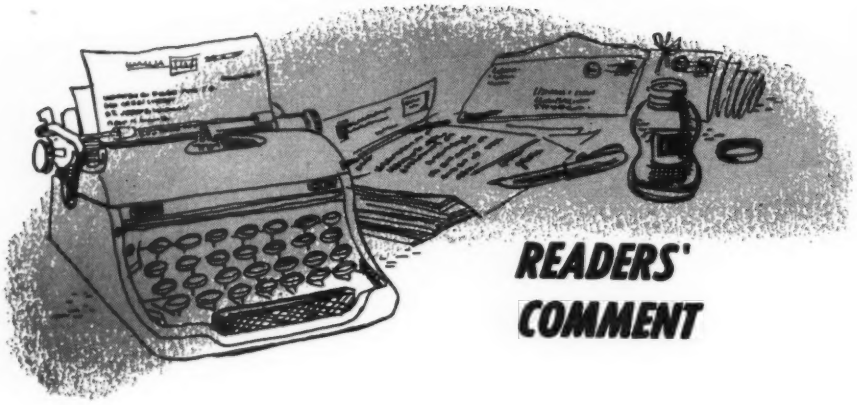

READERS' COMMENT

Consultant Vs Plant Engineer

Sir:

Could I obtain several tear sheets of your very interesting article by Mr. John C. Hitt, entitled "The Consultant and the Plant Engineer."

Mr. Hitt might have added that the consulting engineer can also serve as the whipping boy for the plant engineer and take the heat off in case there is something the owner doesn't like about the new installation; a distinct psychological advantage to the plant engineer.

Fred L. Pearson
Consulting Engineer
Detroit, Michigan

Sir:

In your May 1954 issue, Mr. John C. Hitt authored an excellent article on "The Consultant and the Plant Engineer." Not only was it well written, but it's the type of material that is helpful to the executives of companies using consultants.

Once they understand the role of consultants and how to work with them, quality results will be achieved more quickly and economically than if any misunderstandings are permitted to exist.

C. E. Evanson
President
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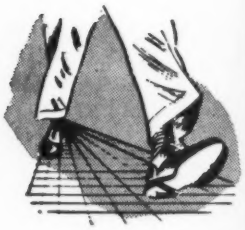

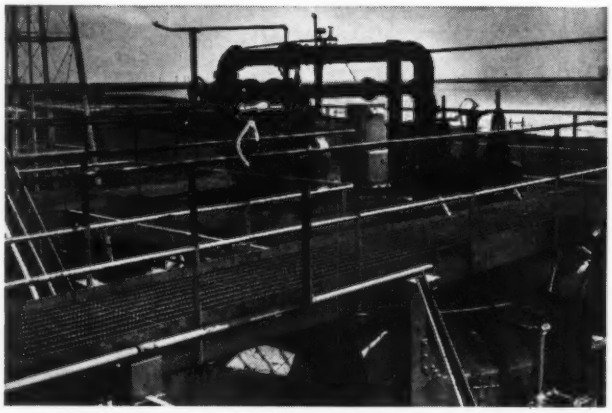

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Chick Austin
Editor, LSU Engineer
Louisiana State University

If You Make More Soup . . .

Sir:

Would you please send us a copy of your publication CONSULTING ENGINEER issued in January, 1954. We are especially interested in the article on Page 28 concerning methods of gathering and maintaining a staff of engineers.

J. W. Marquette
Assistant to Director
of Engineering
Campbell Soup Company

. . . You Need More Cans

Sir:

We would greatly appreciate receiving a copy of your article which appeared on page 28 of the January 1954 issue. The article discussed methods of gathering and maintaining a staff of engineers.

Mary Riordan
Research Department
Continental Can Company, Inc.

Private Practice Only

Sir:

Your letter enclosing the preliminary manuscript on the Minnesota Association of Consulting Engineers [pg 55, this issue] was received yesterday morning, and I presented it to our executive committee last evening, and they approved it.....

One member of the executive committee raised the question that there are some consulting engineers who are employed on a salary basis and are not in private practice and we wish to have it clear that only those who are in private practice or employed by those who are in private practice are eligible to mem-

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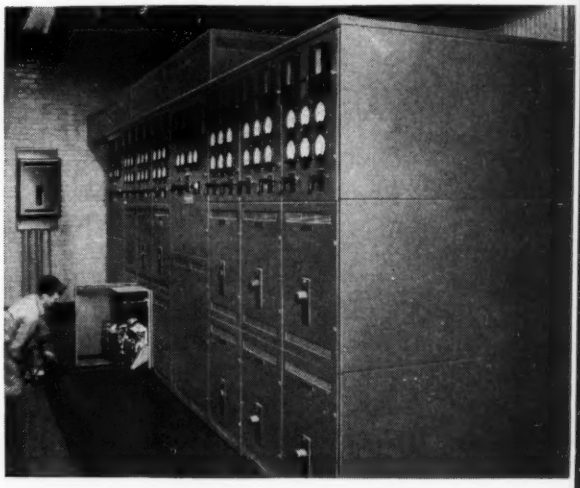

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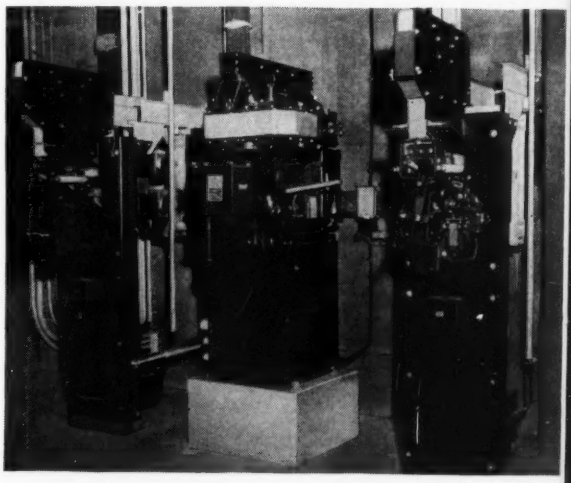

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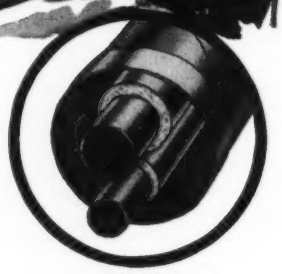

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bership in our association.

The name and address of our new secretary (in the event any of your readers might wish to communicate with our association), is N. Bert Persson, Secretary, Minnesota Association of Consulting Engineers, 1418 Simpson St., St. Paul 4, Minn.

Walter H. Wheeler
Past President
M.A.C.E.

Can't Read All . . . Reads CE

Sir:

I would like to take this opportunity to congratulate you on your excellent publication entitled CONSULTING ENGINEER. It is impossible to read all the engineering publications that pass over one's desk each month—I find however, that I have made it a practice to scan the articles in CONSULTING ENGINEER carefully and feel the time is well spent.

The article in the June issue entitled "Oklahoma Consultants Form Association" was of particular interest as I have felt for some time that the state of Washington should have a similar organization. Where can copies of the constitution and by-laws for the societies now active be obtained.

W. O. Stevens
W. O. Stevens & Company

• WRITE C. C. PATE, 2212 E. 20TH ST., TULSA, OKLA. HE IS SECRETARY-TREASURER, OKLAHOMA ASSOCIATION OF CONSULTING ENGINEERS.

Social Security

Sir:

We noted with considerable pleasure your comment in "Scraps and Shavings" in the June issue of CONSULTING ENGINEER pertaining to the Social Security situation and NSPE's efforts toward exclusion of self-employed engineers. Thank you kindly for your reference to us.

You may be interested in some recent developments which perhaps have already come to your attention, in that Senator George, who is the ranking minority member of the Senate Finance Committee considering this bill, has indicated support of voluntary coverage. NSPE is scheduled to testify before the Senate Finance Committee on July 6, and, of course, we will give Senator George every assistance possible. It is our understanding he has not reduced his feelings to writing, but we are hopeful that he will carry his fight into the Committee and perhaps be successful.

Paul H. Robbins, P. E.
Executive Director
National Society of Professional Engineers

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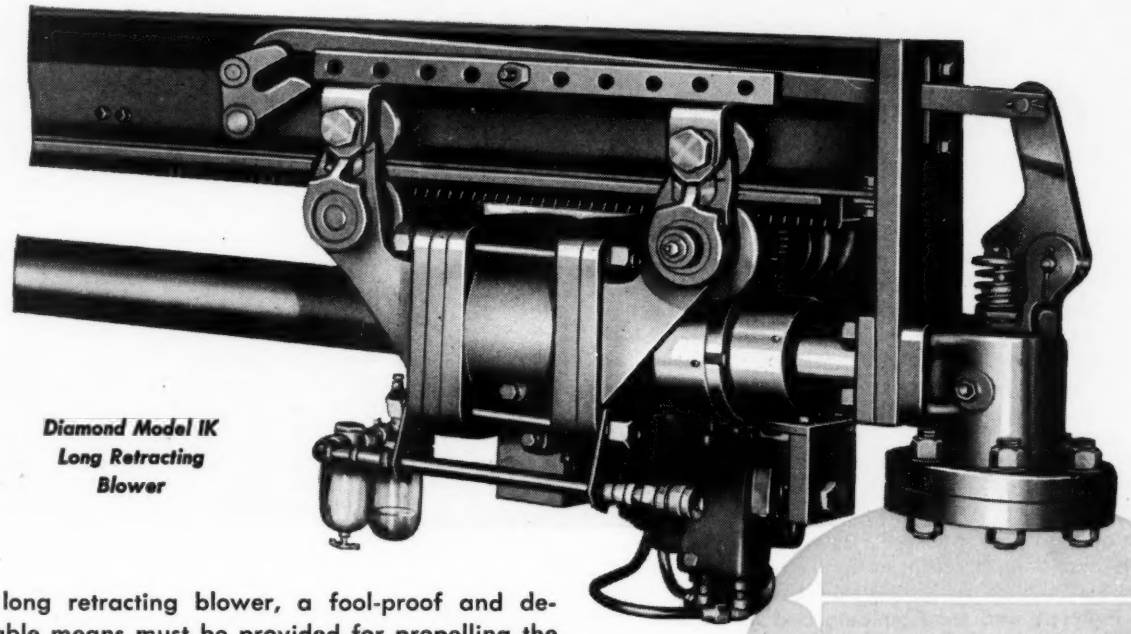

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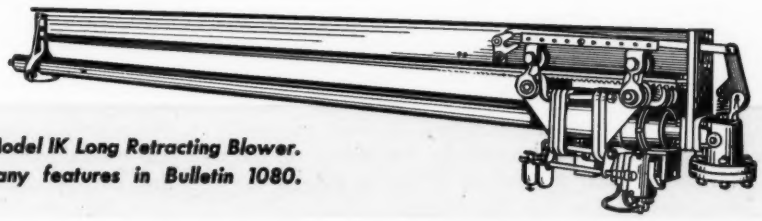
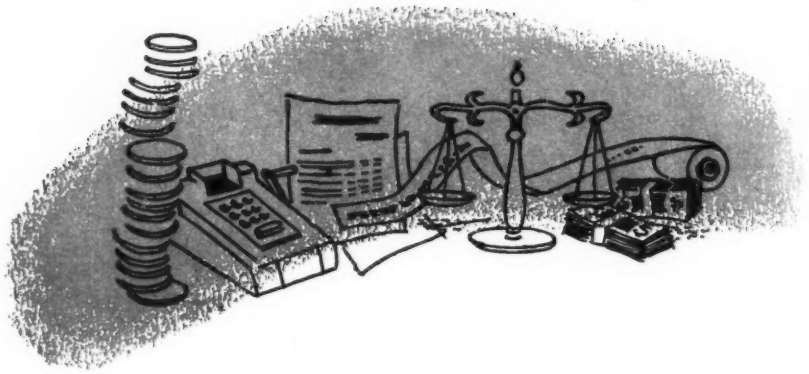


Diamond Model IK Long Retracting Blower. See its many features in Bulletin 1080.

ECONOMIC NEWS NOTES



E. F. Mac Donald
INDUSTRIAL ECONOMIST

BIGGER AND BETTER — Members of the Supermarket Institute have reported that almost one-half of all the operators will build new supermarkets this year. A survey at the May convention of the Institute indicated also that over one out of every four operators plan major remodeling this year. This year's blueprinting of mo.e expansions than remodelings reverses the trend of the last few years.

LONG-TERM BOOM — Commenting on its report that school construction awards in 37 Eastern states in the first four months were one-third higher than a year ago, F. W. Dodge Corp. pointed out that the Census Bureau estimates that "the number of children in every elementary and high-school grade will continue to increase each year at least until 1960." For what may constitute a large school construction program, the House Labor Committee is working out a formula for Federal grants to states on a matching basis.

FEDERAL FILLIP — The highway and school construction lily gets a bit of gilding next year. In accordance with the Federal-aid highway law enacted this Spring, $1.9 billion will be expended over a two-year period for highway and road building and improvement. This is a record appropriation for this purpose. $700 million payments annually are authorized to states in matching funds.

TEXTILE AUTOMATION — A prediction that direct current is slated for an increasingly important position in automation of textile plants was made by Mr. F. D. Snyder of Westinghouse Electric to a recent meeting of the Textile Engineering Division of the American Society of Mechanical Engineers. Pointing out that the textile industry in general has only recently begun to utilize DC equipment's flexibility, he stressed the need for some new form of speed or tension control to sense and correct any change in the tension on yarn or cloth passing through a machine or from one machine to another.

FILE FOR FUTURE REFERENCE — Reporter: "Assuming the downturn is about over and the economy continues along at current levels for five or six months without showing a marked upturn, how would you view the situation?"

Dr. A. F. Burns, chief economic adviser to President Eisenhower: "I would consider that very serious indeed and early steps by the Government would be necessary."

UPBEAT — An increased building volume of new one-family houses is expected by two-fifths of the local real estate boards, according to a recent survey covering 246 communities by the National Association of Real Estate Boards. Another two-fifths look for a continuation of such building at current levels for the rest of this year.

DOWNBEAT — One indication of the extent to which the economy pulled in its horns in the first part of this year is the contraction in consumer credit. In the first four months, total consumer credit outstanding declined over $1.5 billion; last year in the same period, it expanded over $600 million.

FIRE-MAKERS — In a statistical rundown of large-loss industrial fires, the National Fire Protection Association points out that 80% of the 1953 record losses occurred in buildings of non-fire resistive construction, 80% were due to special production hazards, 70% had no automatic fire protection, 60% involved excessive areas, 60% were in small or suburban, areas where in over 40% of the cases, water was not available in sufficient volume to fight the fires.

TOO MUCH TROUBLE? — The Conference on Industrial Defense in the Atomic Age, conducted by the U. S. Chamber of Commerce recently, disclosed an almost universal lack of plans on the part of manufacturing firms for getting back into operation after a bombing attack. Just one of those things that doesn't seem to be worth all the trouble.

BILLIONS NEEDED — Industry will require about $10.4 billion of new capital equipment this year, according to an estimate of the Machinery and Allied Products Institute. In an interesting study of the age composition of the stock of business capital goods, the May issue of ***Capital Goods Review*** estimates that projected replacement requirements of equipment will rise to around $15 billion in 1960. Computed requirements for business plant this year amount to $4.1 billion, rising to $4.5 billion by 1960. The study suggests that "the prospective trend of replacement demand is much better for equipment than for plant . . . (but) the comparatively low level of plant construction in recent years may indicate a better prospect for expansion demand than obtains in the case of equipment."

SO FAR, SO GOOD — At the conclusion of the six-month period for acceptance of bids for its $500 million, 27-plant synthetic rubber industry, the Government was happy to announce that 35 private companies had submitted bids for one or more of all the plants except one of the largest — the reputed high-cost installation at Institute, West Virginia. A three-man commission takes it from here, reporting to Congress next January. The latter has final say-so on all sales.

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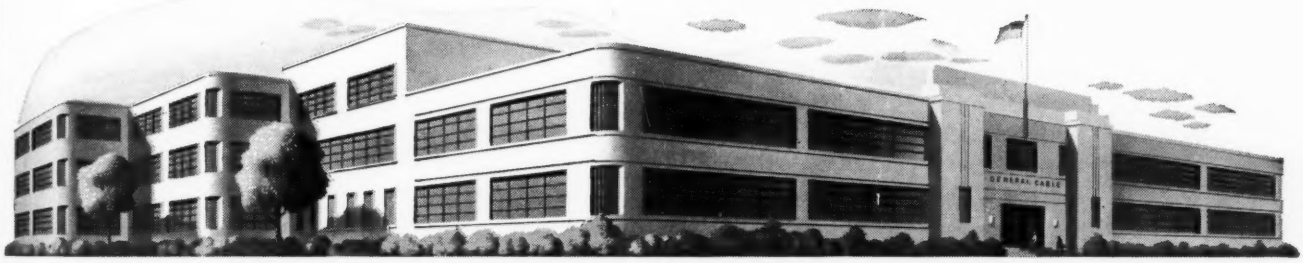

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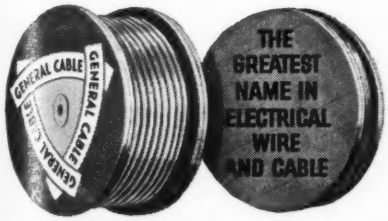

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ATOMS IN ACTION

SWIMMING POOL reactors are going to college. Massachusetts Institute of Technology has announced plans for a privately financed reactor devoted solely to education and non-secret research in peace-time applications. MIT president Dr. James R. Killian is "optimistic that this research reactor will be the forerunner of a power reactor in the (New England) region." And the University of Michigan's Phoenix Project has been allocated fissionable material to fuel its swimming pool reactor.

ONE DOLLAR for services rendered plus the reimbursement of actual costs is the price tag on a contract accepted by Stone & Webster; they will do the architect-engineering service associated with the pressurized water reactor being built for Duquesne Light by Westinghouse. S & W will design the reactor foundations, reactor building, fuel handling facilities, and certain other auxiliaries.

ATOMIC ENERGY applications aside from power continue. A detection technique has been developed that can spot a leak so small that a full year would pass before a single drop would form. A radioactive tracer technique has been announced that precisely determines the erosion in plastics molds caused by the plastic compounds being formed; the method detects one part of metal in 20 million parts of plastic. And a new gamma-ray detection device senses changes in gas or fluid densities to an accuracy of 0.1 percent.

COMPANIES taking new roles in the atomic energy picture include American Locomotive which has just announced that Kenneth Kasschau, formerly of the AEC, will be the manager of engineering in ALCO's new atomic energy products department. The National Lead Company is taking over the operation of the AEC's Raw Materials Development Laboratory from the American Cyanamid Company.

INTERESTING FIGURES relating over-all size and unit costs of reactor power plants were given by Titus LeClair of Commonwealth Edison at the A.I.C.h.E.'s Congress on Nuclear Engineering (see page 80). For a pressurized water reactor using heavy water as the moderator and coolant and using natural uranium as fuel, the following estimates were developed:

Gross Electric Capacity	Total Plant Cost	Cost per Generated KWH
50,000 kw	$37,890,000	22 mills
150,000 kw	$59,000,000	12 mills
200,000 kw	(not quoted)	10 mills

Following LeClair, Williams and Miles, of Brookhaven National Laboratories, proposed that a uranium-in-liquid-bismuth reactor plant could be built for a mere $40 or $50 million to deliver 180,000 kw.

FOREIGN COUNTRIES – some 48 of them – have just been OK'd by the AEC to receive stable isotopes. Since 1947, around 2500 shipments of radioisotopes (radioactive) have been made to foreign countries; now stable isotopes (non-radioactive) are available to them at costs calculated to cover the costs of production.

the Range Finder

DR. GERALD J. MATCHETT

Department of Business and Economics

and

Director, National Center of Dynamic Equipment Policy

Illinois Institute of Technology

THE CHIEF role of the consulting engineer is the investigation of alternative ways of doing things. In order to investigate alternatives, it is necessary to understand the types of costs involved. Which costs are relevant to particular problems? Which costs are not relevant? These are crucial questions that arise when a consultant renders service.

Economic Efficiency

In general terms, management in a free enterprise economy endeavors to make business decisions that will place the firm in the most favorable profit position. In slightly more technical language, the economist uses the term "profit maximization" to describe this behavior.

This is not to say that all decisions are, or should be, based solely on profit considerations. However, where competition is keen and where the margin between profit and loss is not very large, management can not afford to think in terms other than efficiency and profit.

Profits are a function of two variables: revenue and costs. It is the difference between revenue and costs that is to be maximized. Profit maximization is not synonymous with cost minimization, for cost would always be minimized at zero output — but so would income. For many problems, however, it is possible and appropriate to make the simplifying assumption that income is constant, in which case profits are maximized when costs are reduced to a minimum. Such an assumption is warranted where the problem is not one of plant expansion, the introduction of a new product, or the like.

Costs

On the cost side of the picture, the relative importance of different types of costs depends on the enterprise under consideration. No two business organizations are exactly alike, even when they make the same product and operate in the same industry. The difference between businesses becomes magnified when considering two firms producing a different product or service.

In some industries, operating costs or material costs loom large in relation to capital costs. In others, such as the power industry, investment costs are characteristically high in relation to operating and maintenance costs. In the former, material costs and operating costs assume more importance in any investigation of alternatives. In the latter, investment charges occupy a more important place.

Cost Relevancy

Just as all costs are not equally important in arriving at recommendations to management, so costs differ in regard to their relevancy to the problem at hand. The rule regarding cost relevancy is easy enough to state: all costs that will be affected in choosing a particular alternative are relevant and must be included in the analysis; all costs that will not be affected by the decision regarding an alternative are irrelevant and should be excluded from the analysis.

While this rule is easy to state, it is not always easy to apply. There are borderline cases where it is almost impossible to determine the extent to which certain costs are affected by a decision. In addition, the rule is sometimes violated in business practice because of a failure to understand the true nature of economic costs. Finally, the rule must be interpreted in the light of each specific problem. It is impossible to draw up lists of costs in advance and label one category as "relevant costs" and another as "irrelevant costs."

Equipment Replacement

For an illustration, take a limited problem. Should one piece of equipment be replaced by another in a given plant? If the new equipment does not require more time on the part of supervisors, then no expenses of supervision should be charged

against it. If it takes no more floor space than the old equipment, then no floor space charge would be made against it. If it takes less floor space but if the space is not usable for other purposes, then no credit should be given to the new equipment on this score.

In short, no costs of an overhead nature — frequently called "burden charges" — should be applied in the analysis unless it is demonstrably clear that these costs will be changed by the introduction of the new equipment. If such costs as those cited or others will be affected by the purchase of the equipment, they are clearly relevant according to the rule and should be considered.

For another illustration, consider a firm that is contemplating the installation of a machine system of record keeping. It is obvious that one of the cost advantages would be in direct savings of salaries, since a smaller number of clerical personnel would be required. It is a little harder to decide whether there might not be an indirect saving in labor costs as well. With the reduction of clerical employees, the personnel office would have fewer records to keep and fewer persons to recruit and train for specific jobs. If savings of this indirect nature can actually be realized, then it is proper to include them as an advantage for the machine system. However, if the reduction in the work load of the personnel department does not lead to lower costs there, the reduced work load of the personnel department should not be included in the analysis.

Power Plant Modernization

Still a different situation is illustrated by a broader problem — the problem of whether or not to modernize a firm's power plant. What capital costs of the existing plant are relevant to the problem? Suppose that the undepreciated book value of the existing plant is $100,000 and that there is a mortgage of $50,000 against the plant. In order to determine the relevancy of these two items, one must consider whether the present book value or the existing mortgage would be changed by the decision to make the replacement.

It is quite clear that the book value is merely an accounting concept. It represents the portion of the original cost of the power plant that has not as yet been written off as a cost and subtracted from the revenues of the company. The fact that $100,000 appears on the books of the firm has no bearing whatsoever on the economic position of the firm.

As far as the decision on modernization is concerned, the only items of economic value that should be attributed to the existing plant are the net salvage or resale values of any boilers or other equipment that can be sold. This amount would be relevant because it can be realized if the present plant is scrapped and a new plant built. If a new plant is not built, receipts from the sale of equipment must be foregone.

One qualification is necessary, however, at this point. It is possible under present income tax laws that the undepreciated value will have some effect on the amount of income taxes that the firm will have to pay. If there is a change in the income tax position of the company, this is a fact that it is proper, of course, to consider.

Similarly, the mortgage of $50,000 will be unaffected by the decision regarding modernization. This obligation must be paid regardless of the decision. Therefore, it should not enter into the cost analysis in any way when one is considering the economic merits of a particular alternative. Proper determination of the most profitable line of action for a firm to follow can not be made by adding this $50,000 to the cost of modernization as though it were new investment to be recovered in the future.

A safe rule to follow is that any cost that has already been incurred is irrelevant. It is water over the dam, so to speak. The production process cannot be run in reverse. Once an investment is made, an asset is worth only as much as can be obtained for it through sale. If there is no second-hand market, then the asset may be considered to be worth what it would cost to acquire a similar asset in exactly the same condition, regardless of the value at which it is being carried on the books of the company.

Decisions for the Future

Business decisions regarding investment, reorganization, modernization, and the like can affect only the future. Hence in the analysis of alternatives to determine future action, attention should be devoted to costs that will be incurred as a result of a present decision. Costs that have been incurred as a result of past decisions should be excluded from the analysis.

CE quotes

A work week of 30 hours or less probably will be common well before the end of the century. This means we are faced with the problem of satisfying demands of an expanding economy for a greater flow of goods at the same time that the producers of the goods are working fewer hours. The only solution I see is to improve productivity, to increase output per manhour. (The automatic factory is being approached.)

Dr. John T. Rettaliata
President
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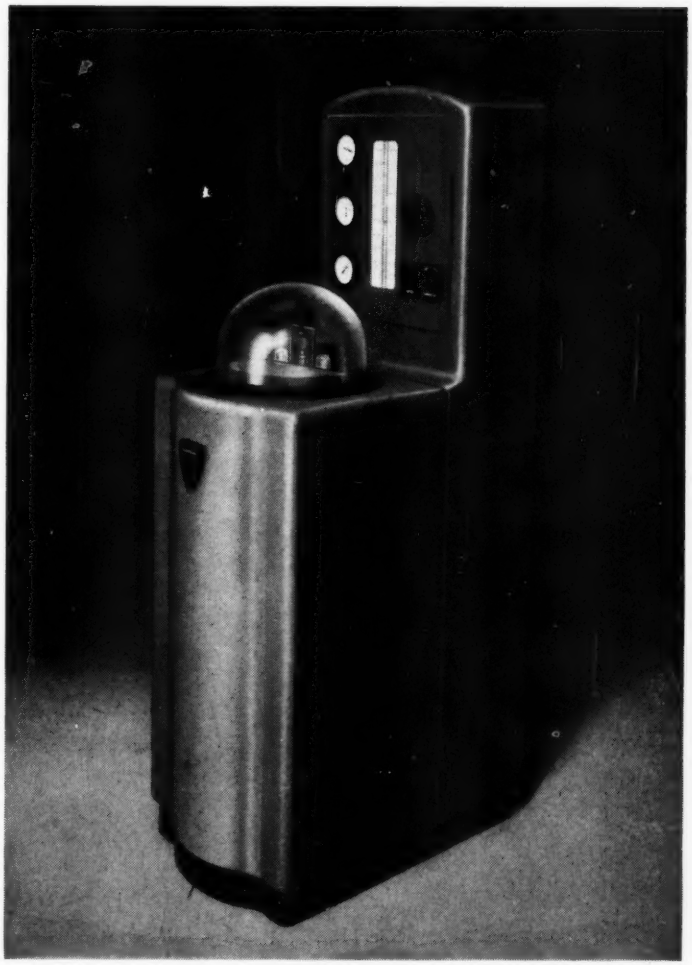

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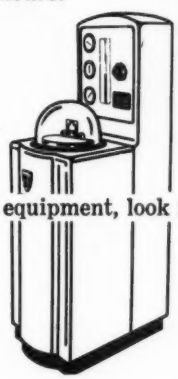

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the Legal Aspect

MELVIN NORD

Consultant in Legal and Technical Problems
Registered Professional Engineer
Chemical Engineer
Patent Attorney

SOME RECENT court decisions regarding contracts have particular relevance to consulting engineering practice.

In Havard et al. v. Board of Supervisors of Humphreys County, 70 So. (2d) 875 — a Mississippi case decided on March 15, 1954 — Mr. Havard had contracted to construct classrooms and a gymnasium according to plans and specifications prepared by the architect of Humphreys County School District. The contract contained a guarantee against defects in workmanship for a period of one year from final acceptance. Four months after the work had been completed and Havard had been paid, a large area of the gymnasium floor buckled up. This was attributed to dampness underneath the subfloor.

The Board of Supervisors of Humphreys County then spent $3051 for the needed repairs and sued Havard and his surety for that sum. At the trial, the architect claimed that if the building had been built according to plans and specifications the water would not have come in, but no evidence was given to show in what respect the contractor failed to follow the plans and specifications. No evidence was given of faulty workmanship or of the use of defective materials. A jury verdict of $3051 damages was given against the contractor and appealed from. The upper court reversed the judgment on the grounds that a contractor is not liable for damages which result solely from the defective plans and specifications.

Explosion

Another construction contract case involving a claim of faulty workmanship is Richmond Redevelopment & Housing Authority v. Laburnum Construction Corp., 80 S.E. (2d) 574 — a Virginia case decided on March 15, 1954. In this case, a gas explosion occurred almost five years after completion of construction, damaging one of the buildings of the housing project. The explosion was apparently caused by a faulty union. The defect was not evident to anyone before the explosion.

The contract contained a provision to the effect that the contractor would "remedy any defects in the work and pay for damages which appear within one year of final acceptance." The question at issue was whether this defect "appeared" when the faulty union was installed or when the explosion occurred.

On appeal, the Supreme Court of Appeals of Virginia held that the defect existed when the union was *installed,* and that therefore the contractual limitation of one year did not prevent liability from arising. Liability did arise — it arose more than five years before the suit was brought. At this point everything seemed fine for the Housing Authority, but they lost anyhow. Unfortunately for them, the statute of limitations in Virginia on such actions is five years, and the faulty union had been installed more than five years before the action was brought. Therefore the action was barred and the decision was for the contractor.

The peculiar aspect of this case is that if the cause of action had been held to arise when the defect was *discovered* (instead of when the faulty union had been installed), the Housing Authority would still have lost, because of the one year limitation provided in the contract!

Interpretation

Questions involving the interpretation of a construction contract were involved in Hensler v. City of Los Angeles, 268 (2d) 12 — a California case decided on March 23, 1954. One provision in the contract stated "the engineer reserves the right to make such changes . . . in the . . . quality of the work as may be considered necessary or desirable to complete fully and acceptably the proposed construction in a satisfactory manner provided such alterations do not change the total cost of the project . . . by more than 25 percent . . ." The work

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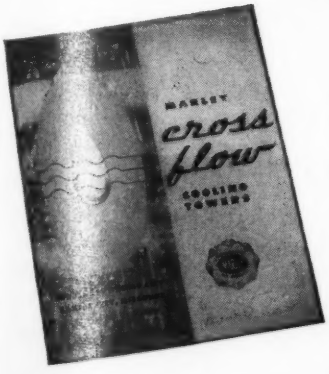

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omitted amounted to 20 percent of the total, namely, the elimination of projected runways, extensions, and taxiways at the Los Angeles International Airport. This left a gap between the new and old runways, which was later filled in by another contractor. On this point, the court held that the intention of the parties was to do a "complete work of public improvement," and that the changes ordered by the engineer prevented this from being done. Damages of over $38,000 were given for this particular breach of contract.

A second point of issue in the Hensler v. City of Los Angeles case involved a five-day stop order issued by the engineer. The contract provided that the engineer would have the authority "to suspend the work . . . for such periods as he may deem necessary, due to . . . conditions, . . . considered unfavorable for the suitable prosecution of the work." The court allowed additional damages of over $1700 for expenses necessitated by the shutdown, because the contractor was never informed as to the reasons his operations were unsatisfactory or for the stop order. The court found as a matter of fact that a five-day stop order was not reasonably necessary — particularly where the contractor was never given an opportunity to alleviate the difficulty involved.

Arbitration

A question involving arbitration in a construction contract was raised in Creter v. Davies, 103 Atl. (2d) 392 — a New Jersey case decided on February 25, 1954. Creter, as owner, and Davies, as general contractor, entered into a building contract which contained a provision for arbitration of disputes before the American Arbitration Association. A dispute arose as to a claim for payment for work performed and losses incurred by the contractor; the court directed the parties to submit to arbitration, and they did. An award of $6400 was made to Davies. The award was signed by two of the three arbitrators on the case.

Creter argued that the controversy was not arbitrated and that the award was not signed by a majority of the arbitrators at the same time and place. The court upheld the arbitration award, stating that the dispute was arbitrative and that it was binding when signed by a majority of the arbitrators, regardless when and where they signed.

General Rule

The general rule under the common law is that there must be unanimity of conclusion among arbitrators unless otherwise provided. However, it was provided in this case that the commercial arbitration rules of the American Arbitration Association were to be followed; they required only a majority vote. Furthermore, the strict rule of the common law has been changed by statute in most states, a majority vote now generally being adequate. It is still the rule, however, that all the arbitrators must participate in the entire proceeding in order for the award to be valid.

It should also be kept in mind that although a general agreement to arbitrate all future disputes is not enforceable at common law in the absence of statute, an arbitration award after a fair hearing has always been held to be valid. Virtually every state now has some sort of arbitration statute, making certain kinds of arbitration agreements enforceable; the statutes do vary considerably from state to state.

Thus, whenever an arbitration clause is involved in a contract, it is important to know precisely what the arbitration statute in the particular state says. One cannot judge on the basis of the common law or on the basis of what happens in another state.

Consultants Get The Treatment

Consulting engineers got some treatment at the first Sanitary Engineering Workshop held some weeks ago in Cincinnati. One industrialist chided "Consulting engineers want to make waste surveys but we have to put one man on each side of them to guide them through the plant. We show them the procedures and processes and then we have to do analytical work for them. We are not exactly happy about this approach to our problems. And we are not sure that our secrets will be kept confidential."

Coming right back, F. W. Jones, partner in Havens & Emerson, said that consultants are not as bad as they are painted; industry is to blame if the results of consulting services are unsatisfactory. "There are two things management must do for itself," according to Jones; "(It) must decide these questions: Is the engineer competent? Is the engineer honest?"

B. A. Poole, chief engineer of the Indiana Board of Health, added "Industry is missing a bet by not retaining qualified consultants and by not paying them an adequate fee for a comprehensive preliminary report. Some people 'around the edges' take advantage of . . . opportunities, but careful investigation of an engineer's background will help to get the right man for the right job."

The sessions were sponsored by the Cincinnati Section of the ASCE.

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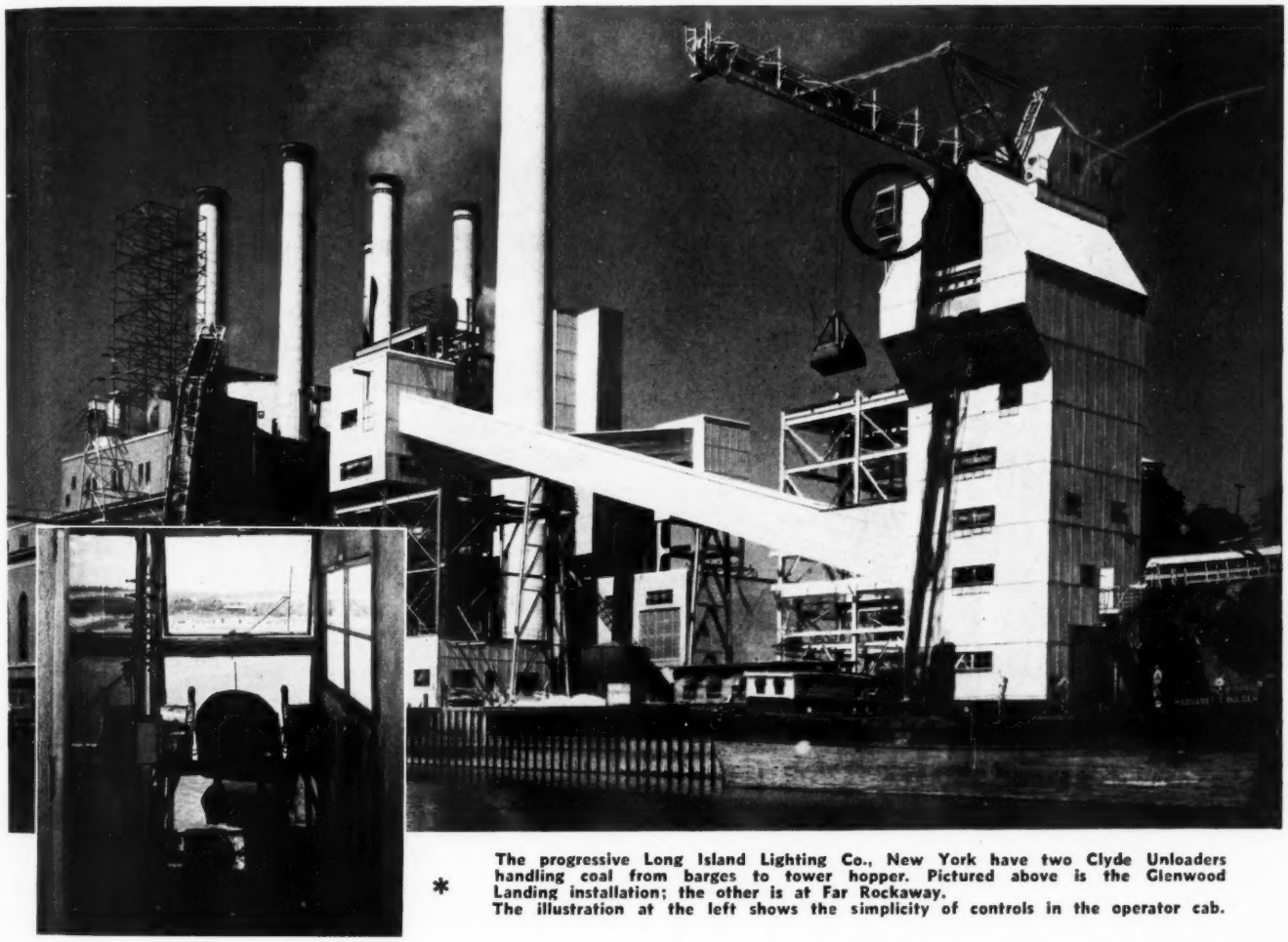

* The progressive Long Island Lighting Co., New York have two Clyde Unloaders handling coal from barges to tower hopper. Pictured above is the Glenwood Landing installation; the other is at Far Rockaway.
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IN THE PAST, engineers' services were limited chiefly to the technical phases of design, development, and construction. However, with the accelerated pace of technology, engineers are rapidly becoming the focal point for the planning and development required by the larger, more complex projects of today.

More and more frequently the client expects the consulting engineer, because of the breadth of his previous experience, to be in a position to advise on such factors as material and labor costs, selection of equipment and materials, economic considerations in process layout, operation and maintenance, and analyses of such factors as depreciation and obsolescence. To furnish such added services requires skills which go beyond the engineer's office and drafting room. Thus, the consulting engineer must have sound economic advice, legal talent, accounting and tax specialists, and purchasing personnel familiar with an ever-changing equipment price market.

Turn-Key Projects

Also, there is a growing tendency on the part of many clients, particularly in specialized industries such as the chemical process and petroleum fields, to expect the engineering firm to quote a turn-key proposition. To handle this type of a project, it is necessary to organize on an omnibus service basis to provide the planning, engineering, designing, purchasing, expediting, construction, and operation of the required facilities.

Since the project can be considered a tool to be used by the client to produce a product and conduct business at a profit, the engineer can offer major service if he has the means and facilities to provide data for determining how the project will fit into the price structure of the client's product. To a large degree, the price of the end product will depend on the site selected for the plant.

Generally the site selected must fulfill a number of rigid requirements, and therefore its selection will require all of the skills available in the organization. A site committee, composed of project consultants, a land surveyor, an economist, a lawyer, and a tax and insurance expert, will assure that none of the factors are overlooked and that each factor is carefully considered as a separate entity and also as it affects the entire program.

A careful analysis and a proper weighing of all factors favoring the site will generally suggest the most economic process to be used at the location. Many large contracting engineering firms have built their reputations on designs and processes developed within their organizations in such fields as chemistry, petroleum, paper, and food. The accumulation of well catalogued standard designs and specifications, based on past experience, is of inestimable value to the engineering office in putting together a complete proposal for costing purposes. It is in this phase of planning that the engineering firm lays the basis for economical design and construction of the proposed facilities.

Repetitive Work

Good management of the engineering functions can result in a significant saving in design cost. Beyond the preliminary planning phase, much of the work in engineering can be classed in the repetitive function category. Varying estimates have been made as to the amount of engineering work that is routine and repetitive, some of these going as high as 90 percent — with a minimum of 10 percent spent in creative planning and development. Therefore, any method which tends to reduce the time required by routine and repetitive functions increases the time which can be spent in improving designs, processes, layouts, and developments of new forms of equipment. In the competitive times ahead, this can mean the difference between the success and failure of the consultant's business.

A recognition of those portions of the engineer's

work that can be reduced to routines easily executed by junior engineers or sub-professional technicians can result in a more streamlined flow of work through the office.

Fill-In Forms

Many offices have developed fill-in type forms to simplify the specification, requisitioning, and purchase of such equipment as pumps, motors, turbines, compressors, fans, starters, and even switchgear and instrument assemblies.

Standardized flowsheets for sections of plants or processes similar to previous designs also can be used. These serve as a checklist, as a data sheet for information to the drafting room, and as a means of passing relatively complete pictorial specifications to the requisitioning clerks.

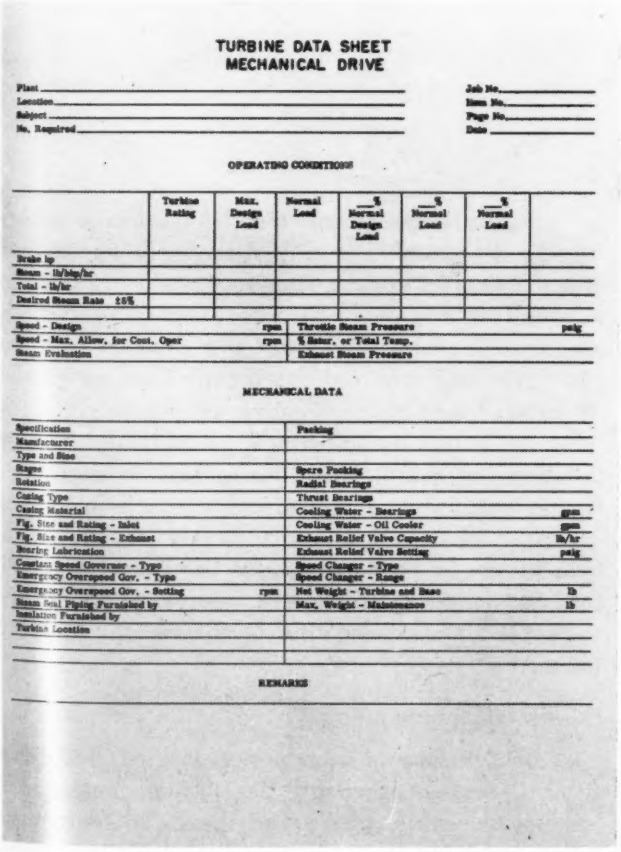
Still another means of reducing repetitive work is the standard request or requisition form. This form can be used to ensure a smooth flow of information from the engineer through requisitioning, drafting, purchasing, and control by standardizing methods and instructions to the vendor on such important matters as delivery time, vendor's drawings, instructions, field erection, and supervision.

With a properly prepared set of forms, a routine line of communication can be set up between the engineering department and the drafting room. It has been found from experience that the time required to produce drawings is inversely proportional to the amount of detailed information properly conveyed to the draftsmen. And by skillful use of labor saving devices, more qualified engineers now engaged at drawing boards can be utilized in the engineering department. These men can then direct their efforts toward greater detail in the designs, thus resulting in a reduction of the number of drawing changes and, what is more costly, changes in the field. Close control of each engineering function also results in savings in drafting time.

Reduced Drafting Time

One office reported that the average time required for drawings had been reduced from 25 man-days to ten man-days by such procedures. In addition, these drawings carried more information than the former, and experience has proven that they have significantly contributed to lower installation costs because of the added detail.

The development of these standardized forms does not in any way reduce the engineer's responsibility. Only in the hands of competent engineers do fill-in specifications and time-saving forms become useful devices, and it should be emphasized that



TURBINE DATA SHEET
MECHANICAL DRIVE

Plant _____ Job No. _____
Location _____ Item No. _____
Subject _____ Page No. _____
No. Required _____ Date _____

OPERATING CONDITIONS

	Turbine Rating	Max. Design Load	Normal Load	___% Normal Design Load	___% Normal Load	___% Normal Load	
Brake hp							
Steam - lb/bhp/hr							
Total - lb/hr							
Desired Steam Rate 25%							

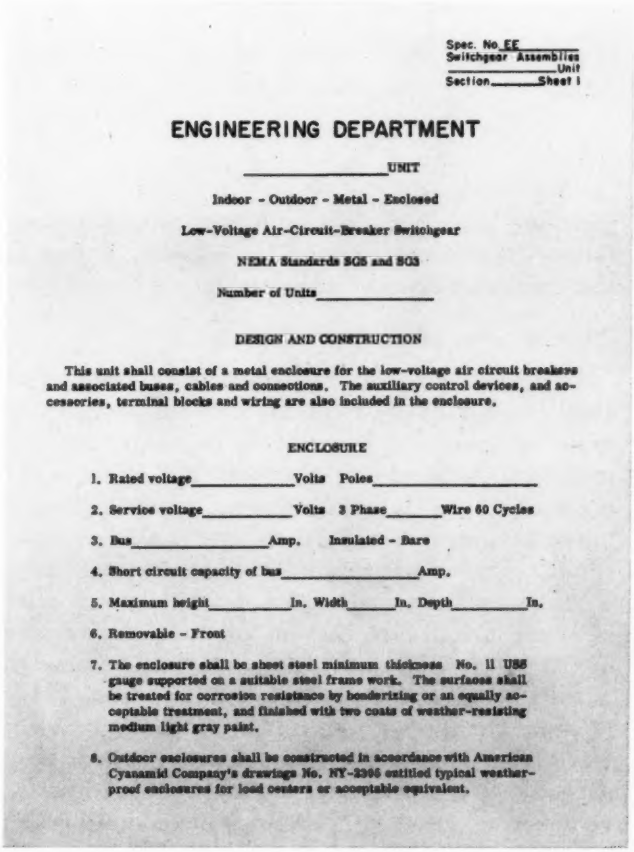
Speed - Design	rpm	Throttle Steam Pressure	psig
Speed - Max. Allow. for Cont. Oper	rpm	% Satur. or Total Temp.	
Steam Evaluation		Exhaust Steam Pressure	

MECHANICAL DATA

Specification		Packing	
Manufacturer			
Type and Size			
Stages		Spare Packing	
Rotation		Radial Bearings	
Casing Type		Thrust Bearings	
Casing Material		Cooling Water - Bearings	gpm
Fig. Size and Rating - Inlet		Cooling Water - Oil Cooler	gpm
Fig. Size and Rating - Exhaust		Exhaust Relief Valve Capacity	lb/hr
Bearing Lubrication		Exhaust Relief Valve Setting	psig
Constant Speed Governor - Type		Speed Changer - Type	
Emergency Overspeed Gov. - Type		Speed Changer - Range	
Emergency Overspeed Gov. - Setting	rpm	Net Weight - Turbine and Base	lb
Steam Seal Piping Furnished by		Max. Weight - Maintenance	lb
Insulation Furnished by			
Turbine Location			

REMARKS

FILL-IN FORMS FOR SPECIFYING SUCH EQUIPMENT AS STEAM TURBINES ELIMINATE REPETITIVE WORK.



Spec. No. EE_____
Switchgear Assemblies
_____Unit
Section_____Sheet 1

ENGINEERING DEPARTMENT

_____UNIT

Indoor - Outdoor - Metal - Enclosed

Low-Voltage Air-Circuit-Breaker Switchgear

NEMA Standards SG5 and SG3

Number of Units_____

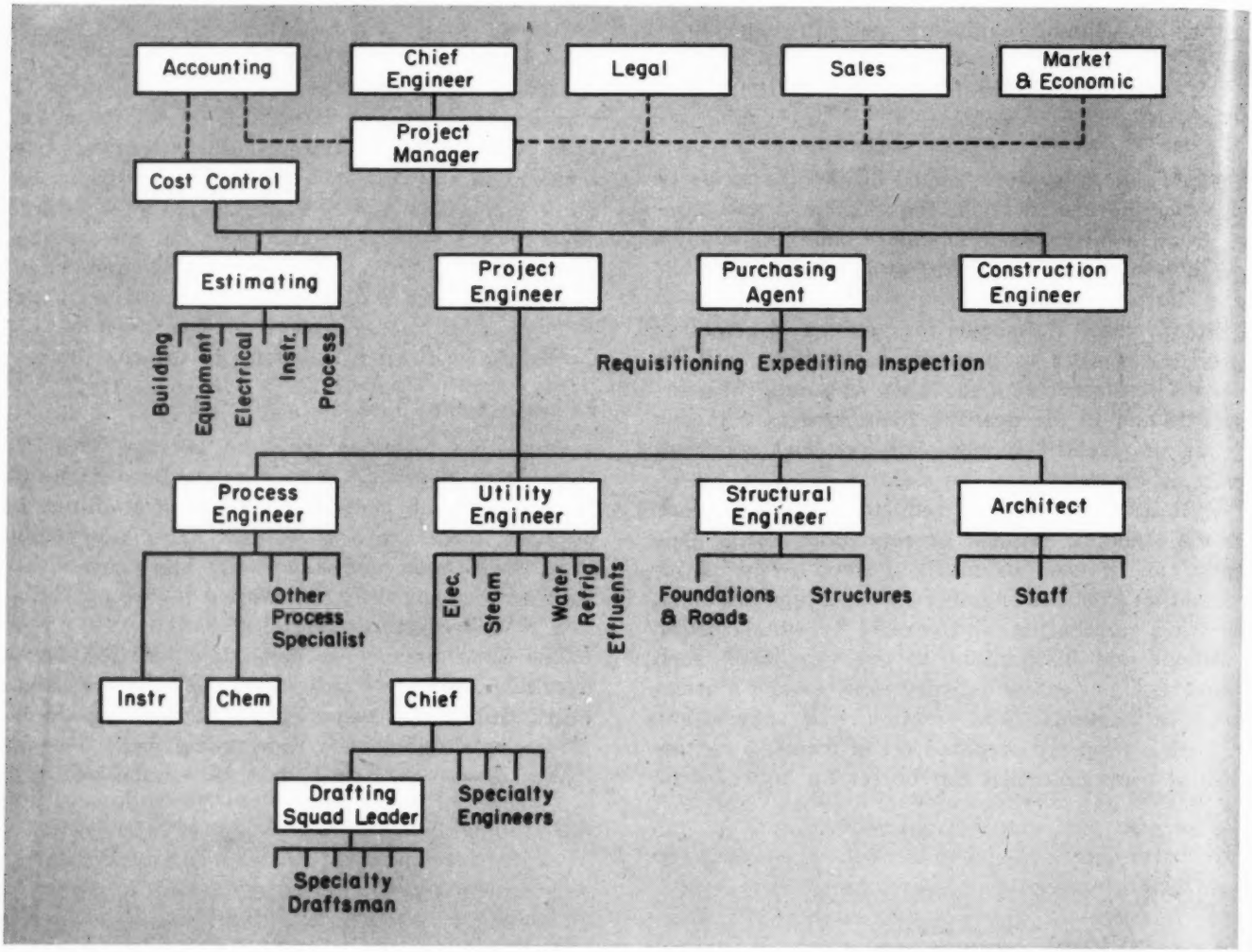
DESIGN AND CONSTRUCTION

This unit shall consist of a metal enclosure for the low-voltage air circuit breakers and associated buses, cables and connections. The auxiliary control devices, and accessories, terminal blocks and wiring are also included in the enclosure.

ENCLOSURE

1. Rated voltage_____Volts Poles_____
2. Service voltage_____Volts 3 Phase_____Wire 60 Cycles
3. Bus_____Amp. Insulated - Bare
4. Short circuit capacity of bus_____Amp.
5. Maximum height_____In. Width_____In. Depth_____In.
6. Removable - Front
7. The enclosure shall be sheet steel minimum thickness No. 11 USS gauge supported on a suitable steel frame work. The surfaces shall be treated for corrosion resistance by bonderizing or an equally acceptable treatment, and finished with two coats of weather-resisting medium light gray paint.
8. Outdoor enclosures shall be constructed in accordance with American Cyanamid Company's drawings No. NY-2305 entitled typical weatherproof enclosures for load centers or acceptable equivalent.

SPECIFICATION SHEET FOR SWITCHGEAR SIMPLIFIES SPECIFYING, REQUISITIONING, AND PURCHASING.



DUPLICATION OF EFFORTS ON LARGE PROJECTS CAN BE EFFECTIVELY REDUCED BY DEFINING RESPONSIBILITIES.

their use does not make automatons of engineers. Rather, it releases more of the engineer's time for the creative phases of engineering.

Organizing the Work

To effectively use the engineering skills made available by these methods, the engineer's work must be organized to function smoothly and with minimum duplication of effort. An effective job organization starts with a project manager answering to top management and charged with the responsibility of coordinating all phases of the program.

The project manager acts as the liaison officer between client and firm and conducts the business of the project. He must understand and know the client's business, the product, and the means of production. He needs to be on familiar terms with contract labor conditions, construction methods, legal aspects, and accounting methods, in addition to engineering. His staff should include a project engineer, estimators, purchasing agents, accountants, construction engineers, and legal talent.

The project manager has little time to devote to details of engineering. This function must therefore be delegated to a project engineer on his staff. It is the project engineer's responsibility to organize a group of engineers to direct the efforts of the engineering teams handling the various branches of engineering required. Such controlled assignment of duties forestalls duplication of work.

An important assignment is the heat and material balance for the project. Since this is used as a design guide and to control equipment purchase for optimum plant efficiency, it should be one of the first things to be done. Under the direction of the project engineer, utility and raw material data for the project are put together by the various engineering specialists.

Flow of Information

A smooth flow of information is then established from the client through the project manager to engineers and draftsmen and thence to requisitioning, purchasing, inspection, expediting, cost control, and finally construction, using as many time-saving forms and devices as possible to ensure economical

functioning. Job progress can be traced at any time by status reports showing engineering and drawing completion, requisition and purchasing completion, cost position, and other pertinent data.

Important to the coordination of the project are carefully spaced meetings directed by the chief engineer and attended by the project manager and his staff, with representatives of the client's engineers, safety, insurance, legal, and accounting departments present for orientation purposes. At such meetings, information is freely exchanged on standards, applicable safety rules, local and national codes, labor problems, and related subjects. Responsibilities for various phases of the work are defined and delineated to avoid any possible confusion due to overlapping of functions.

Initial and Operating Costs

Among the responsibilities of the project manager and his staff are the decisions having an effect on initial and operating costs of the project. He is constantly faced with the client's demands for low capital expenditure commensurate with low operating costs. The choice of equipment and plant layout largely fixes operating costs for any site, all other factors being equal. Study, based on experience, will yield a layout requiring minimum

—Continued on page 72

Assigned Req'n No. _____

Engineering Department
REQUISITION DATA SHEET
For Material &/or Equipment

Job No. _____ Date __/__/__ Sh. ____ Of ____
Original req'n ☐ Change req'n ☐
If change req'n
(a) Orig. req'n no. ____ (b) Order no. ____
(c) Vendor _____
TITLE
SHIP TO: Job site ☐ See attached ☐
Delivery wanted: __/__/__

Item	Quantity	Description (Include tagging identification)	Code

IN ACCORDANCE WITH: Specifications ☐ Drawings ☐ Listed below ☐ On attached list ☐

DRAWING AND/OR SPECIFICATION LIST

Item	Drwg. or Spec. No.	Condensed Title

THE FOLLOWING ARE REQUIRED: (a) Certified dimension prints including load distribution for foundation requirements ☐ (b) Wiring diagrams ☐ (c) Operating & maintenance instructions ☐ (d) Performance curves ☐ (e) Spare parts list ☐ (f) Motor requisition form filled out by vendor ☐ (g) Drawing approval before fabrication starts ☐ (h) Factory representative for: (1) Aid in erection ☐ (2) Adjust for optimum operation ☐ (3) Instruct personnel ☐ (i) Inspection ☐ (j) ____ prints of vendors' drwgs. by __/__/__ (k) Other _____

REMARKS:

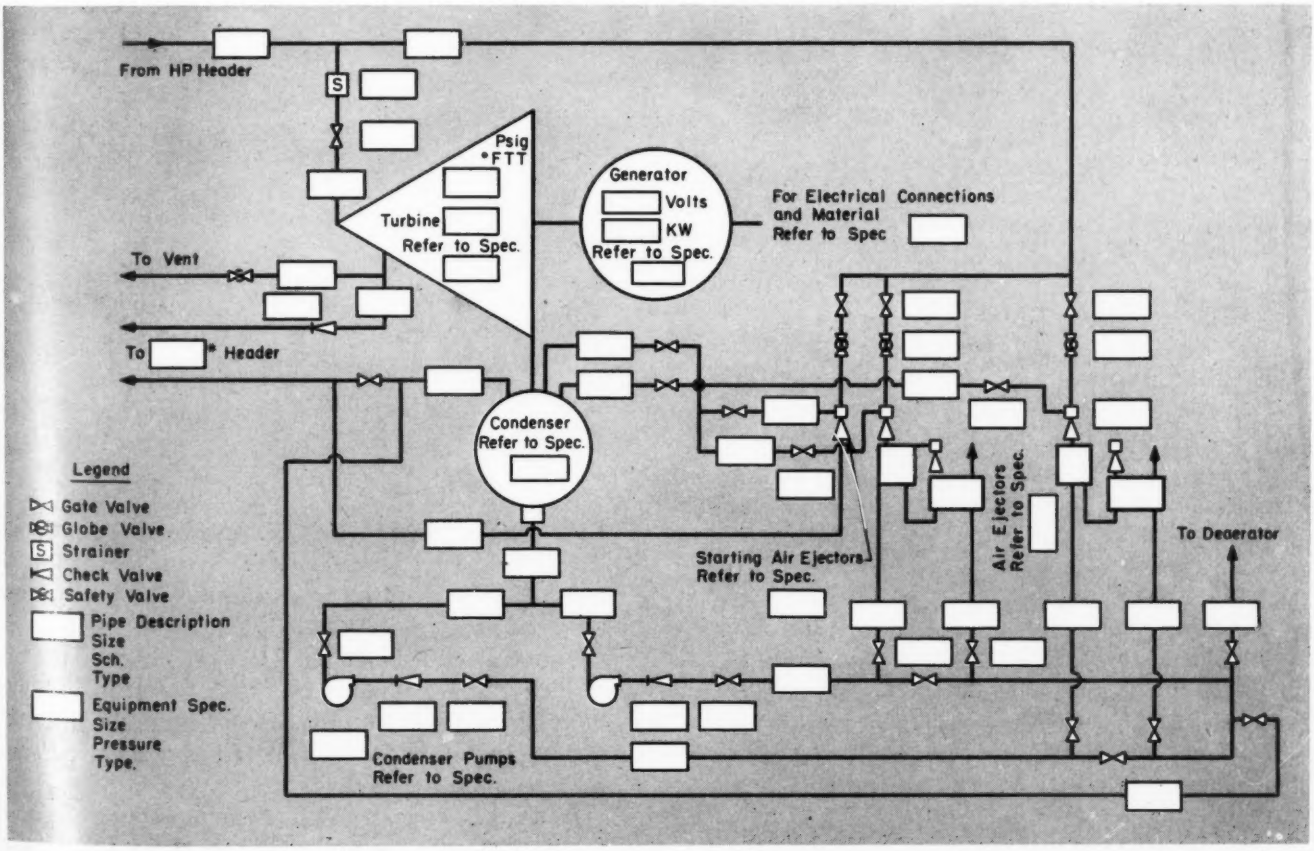
NOTES TO PURCHASING DEPT.

1. Order to be placed by __/__/__
2. Estimated cost as per authorization _____
3. Required design because of:
   (a) Plant standard or preference ☐
   (b) To match existing equipment ☐
   (c) To suit our layout ☐
   (d) See attached ☐
4. Instruct bidder to return filled out questionnaire ☐
5. Bid review requested ☐
6. Suggested bidders:
   (a) _____
   (b) _____
   (c) _____
   (d) See attached ☐

DO-U-____ (ITEM ____)
RATING: or U____-Q ____

Signed by: _____
Approved by: _____

STANDARD REQUISITION FORMS FACILITATE FLOW OF ENGINEERING INFORMATION TO OTHER DEPARTMENTS.



FILL-IN FLOWSHEETS CAN BE USED FOR PROCESSES OF SIMILAR NATURE TO SAVE VALUABLE ENGINEERING TIME.

LET'S CLOSE RANKS IN AN AGGRESSIVE AND UNITED EFFORT TO MAINTAIN OUR PROFESSIONAL AND ETHICAL STANDARDS.

A Fighting Code of Ethics

Engineering is a profession. As a profession, it is responsible for maintaining certain standards — not the least of these being ethical engineering conduct. But what constitutes ethical conduct? And, more important, how can it be enforced? To satisfy all the diverse interests is not easy. While the recommendations are perhaps drastic and certainly controversial, they are a sincere effort to effect higher ethical standards.

THERE IS A moral laxity among consulting engineers in policy making positions that seriously undermines the long-standing confidence our profession has enjoyed.

Four basic problems face the profession. The two most serious are lack of integrity or actual dishonest practices; the other two involve the ignoring of accepted ethical standards of the profession. They may be stated as follows:

1. Giving "kickbacks", "commissions", "finder fees", "payment for influence" to assist in obtaining (or in payment for) engineering work;

2. Accepting commissions or engineering aid di-

rectly or indirectly from contractors, equipment manufacturers, or other parties;

3. Reducing fees below minimum accepted standards or competing on the basis of price;

4. Undercutting the professional reputation of another engineer or attempting to supplant an engineer where steps have been taken to employ him.

Under the present system, it is difficult to detect malpractices by individual engineers or engineering firms. Furthermore, it is usually impossible to obtain positive proof. Rather than become involved in an unpleasant situation, with only a remote possibility of reaching a clear-cut decision, the matter is almost invariably dropped and the malpractice allowed to continue.

Changes are Needed

The lack of a uniform, up-to-date, and fully realistic code of ethics represents a handicap in dealing with these violations. But before any code can operate, two basic premises must be established. Foremost is the need for a collective determined will to find a solution. The entire engineering profession must close ranks if it will meet the common threat to its existence. And second, there is a need to break away from outmoded patterns and to adopt policies that reflect today's problems and conditions. Without these two premises, no effective immediate solution can be expected.

During the past twenty years, I have personally encountered a disturbing number of cases of malpractice among engineers, architects, and contractors alike. During the past eight years, I have had further occasion to learn, through the experiences of colleagues and associates, just how widespread and prevalent dishonesty and moral laxity have become. Yet, those engineers who are willing to assume courageous leadership are in the very small minority compared with those satisfied to "pass the buck" or entirely ignore controversial issues. This inertia may help account for the lack of outspoken articles on ethics in our technical literature.

It is interesting to note that as a general rule these malpractices exist in locales where corrupt political administrations are tolerated. In fact, the misuse of the construction industry and its heavy publicly subsidized appropriations is one of the important means of support of corrupt government.

The ethical problems dealing with fee cutting and bidding for professional work were very ably presented by F. H. McDonald, Consulting Engineer, in two recent articles (CE, June 1953 and Feb. 1954).[2,3] A great deal of concern was recently felt about state and federal provisions requiring bids for engineering or architectural services. And the problem became acute when some firms felt obliged to comply in order to obtain work so advertised. An exceptionally able article[4] by W. N. Carey, Executive Secretary of the A.S.C.E., shows that competitive bidding for professional services is not required by law and that this principle has been consistently upheld by our state and federal courts.

The problem of fee-cutting and undercutting of other engineers' reputations is far more difficult to conclusively point out. The problem is well-stated by Mr. McDonald in his last article when he says, "Who has the reach to name the guilty? Who has the force to change their practice?"

Unless a mechanism is available to discover and name the guilty—those who place money and job-getting above integrity and ethics—their malpractices will continue indefinitely. These relatively few men harm not only themselves and their associates but weaken the very foundation upon which the engineering profession has been built.

If we are going to be successful in eradicating malpractices, adequate measures must be taken. Certain basic principles were outlined by the author about a year ago.[1] Since then, they have been discussed at length in groups and individually with over a hundred engineers. The reaction has been varied, the majority of the men being more concerned with implementing the details of the program rather than with altering or eliminating the suggested fundamental precepts:

1. Architects and various engineering societies must agree on a modern, aggressive, high level code of ethics which would clearly define the methods to be used to secure a job—no "commissions", "finder's fees", or "kickbacks" of any kind would be tolerated.

2. Competent accountants would be employed to set up a single standard system of bookkeeping which all cooperating firms would follow.

3. Selected honest accounting firms would be

—Continued on page 74

JOHN R. SNELL

Head, Department Civil and Sanitary Engineering
Michigan State College

Dr. John R. Snell came to Michigan State in 1952 after almost twenty years of sanitary engineering practice. Graduating successively from Vanderbilt, U. of Illinois, and Harvard, Dr. Snell has been associated with some of the larger East coast consultants, organizing his own firm, Engineering Services, Inc., in Boston in 1948. Earlier, he spent four years working abroad in China and Venezuela.

Tubewrights Ltd.

TRUSSES AND GIRDERS OF ROTAX PLANT WERE PREFABRICATED. WELDED CONSTRUCTION WAS USED THROUGHOUT.

English Plants Demonstrate Economy of

Tubular Frame Construction

CE exclusive

THOMAS BEDFORD
Consulting Engineer

Thomas Bedford, an English consultant, entered private practice in 1939. Previously, he served as London manager of the structural department of Boulton & Paul Ltd, structural engineers. He also has been associated with several Canadian firms. In recent years, he has played a leading role in the development of tubular frame construction for industrial buildings, holding the opinion that there is a wide and growing field of application for this form of construction. In addition to designing the tubular frame buildings which he describes in this article, two 130-ft span, 240-ft long x 35-ft high aircraft hangars, employing his tubular frame design, are now being constructed.

THE EUROPEAN steel shortage, which persisted until quite recently, has caused structural engineers to look for a means of saving material without sacrificing the strength provided by rolled sections. One result has been the development of tubular construction, which recently achieved new significance with the completion of two, all-welded, tubular steel frame factory buildings in England. With floor areas of 165,000 sq ft and 141,000 sq ft respectively, they are the largest all-welded structures ever built.

The design, development, and production of

standard tubular structures was pioneered in England. The Forth and Menai railroad bridges are early examples, but tubular construction has become a practicable and economic proposition only with the advent of new welding techniques. This more recent evolution began about twenty years ago, was held up by the war, and has now made very significant progress.

Today, tubular structures form an important British export commodity. In the past four years, the Arcon group of companies, alone, exported prefabricated tubular structures worth $11,200,000 to seventy-two countries throughout the world. These buildings have been used for housing projects, industrial plants, churches, hospitals, and schools. They even include complete "packaged cities". Tubular steel as a construction medium has been used for roof trusses, storage sheds, aircraft hangars, footbridges, single-story factory buildings, towers, and jib cranes—the outstanding example being the world's largest dragline with a tubular jib 282 feet long.

Tubular Frame Factories

Both of the new factories were built by Tubewrights Limited, a subsidiary of Stewarts & Lloyd, the largest producer of steel tubes in the United Kingdom. One of the two plants was built for Tubewrights' own use, while the other was constructed for Rotax Limited at Hemel Hempstead, Hertfordshire.

The larger of the two plants is the Rotax factory. The main production shop is 360 feet long and 460 feet wide, consisting of seven 60-ft bays and one 40-ft bay. Tubular columns are spaced at 60 feet and 40 feet to suit production needs. Roof trusses, carrying glazed monitors, have a span of 60 feet, spaced on 13-ft, 4-in. centers. Intermediate trusses are carried on 40-ft long cross girders.

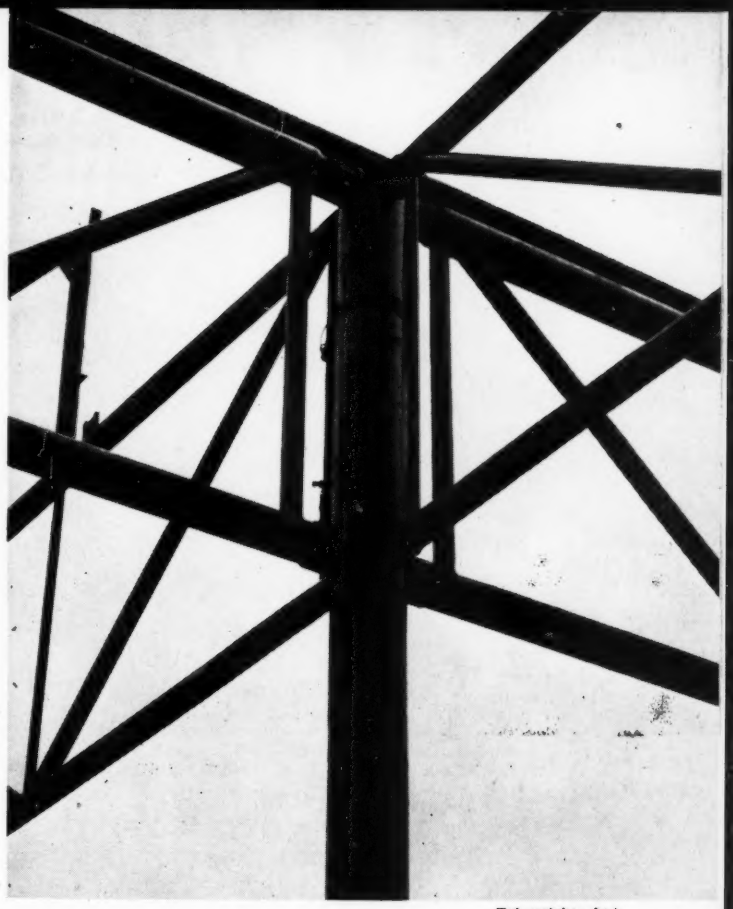
Total weight of steelwork in the superstructure is 460 tons. This includes 205 tons for the roof trusses and monitor frames, 64 tons for the roof girders, 39 tons for the columns, 147 tons for the purlins, and 5 tons for bracing.

The steelwork was prefabricated as much as possible at the works, and is of all-welded construction. With the exception of the foundation anchor bolts, bolts were not used—not even for erection purposes. The trusses and girders were delivered to the building site as complete units.

The second tubular factory, built by Tubewrights Limited for their own use at Kirkby, near Liverpool, was fabricated entirely on the site. Tubes were delivered in approximate lengths and were shaped, welded, and erected by the company's own labor.

Although the Rotax plant was prefabricated at the works, while the Kirkby plant was fabricated in the field, costs between the two methods are not comparable since the latter was constructed by the manufacturer, using its own men. Prefabrication does ensure better facilities for supervising the quality of workmanship; however, it may be more economical to carry out the fabrication of large assemblies on the site.

A total of thirty men were used to construct the Kirkby plant. Six of these men were employed on preparation of the material, while ten were used for fabricating and fourteen worked on assembling.

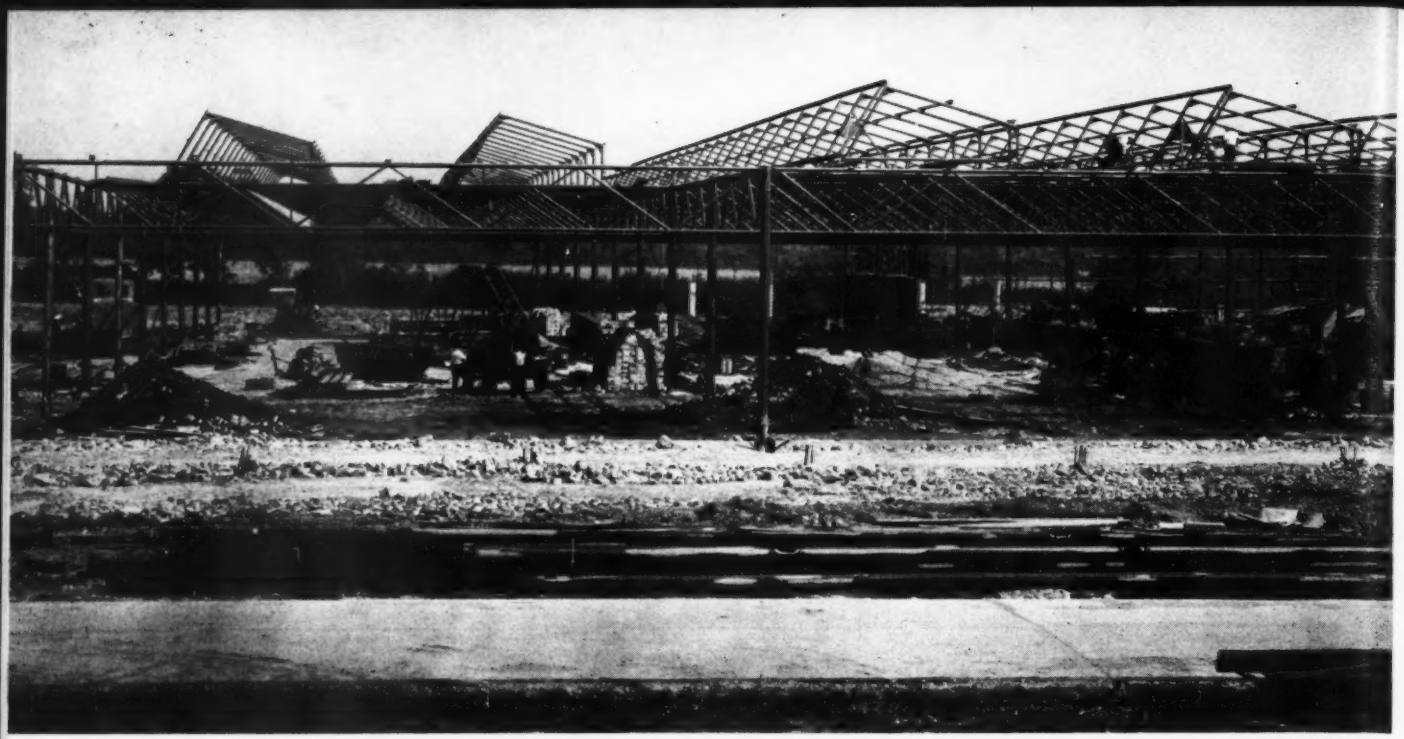


Tubewrights Ltd.

WELDED CLEATS, USED AT ROTAX, ELIMINATED NEED FOR BOLTED CONNECTIONS WHEN SETTING TRUSSES.

COMPLETED EAVES COLUMNS FOR TUBEWRIGHTS' KIRKBY PLANT. OUTSIDE DIAMETERS ARE 5⅝ INCHES.

Tubewrights Ltd.



Tubewrights Ltd.

ROTAX PLANT IN NINTH WORKING WEEK. ALL COLUMNS ARE UP AND STEELWORK FOR FOUR BAYS IS COMPLETED.

The entire project required four months. Individual lattice girders and roof trusses were fabricated on stillages, and the whole structure was erected with the aid of two mobile cranes.

The main shop of the Kirkby plant is 360 feet long and 360 feet wide, divided into six intermediate bays of 40-ft span and two outer bays of 60 feet. The 21 main supporting columns, made from 16-in. diameter tube, carry 21 girders with a span of 120 feet. The total weight of steel used in the finished structure is 415 tons, estimated to be 40 percent less than a similar design using riveted or bolted rolled sections. The low steel content of the structure is highlighted by the fact that the allowance for loads carried by the roof structure to provide for conveyor and equipment is equivalent to a load of 20 lb per square foot of floor area, an increase of nearly 100 percent over the normal dead and live load requirements.

Cost Comparisons

That the tubular-frame all-welded factory building is an economic proposition has been demonstrated by these two plants. The higher basic cost of the tubes is offset by the one-third saving in the quantity of steel. In addition, the reduction in total weight lessens freight charges to the building site, and reduces construction costs. According to an official announcement, the Rotax plant showed an over-all saving of ten percent in cost in comparison with rolled section construction.

Savings in the initial cost of the plant are not the only advantages of tubular construction. Because tubes present a smaller surface area, tubular frames need less maintenance and less painting than a frame constructed from an assortment of rolled sections, with their ledges and inaccessible surfaces. The aesthetic factor also should be considered. The absence of gusset plates and bolts, the symmetry and lightness of tubular sections, and the delicate proportions of the trusses convey a pleasing atmosphere of lightness.

Welding

The major problem in tubular design is welding. Tubes pose two special problems in jointing. Being round hollow sections, they are liable to buckle at the junction of the branch tube to the main tube. Also, it is necessary to make welds which will develop the full strength of the tubes.

Tube-to-tube connections are preferable to joints using gusset plates, since gussets defeat the main advantage of lightness. The need for stiffening joints is determined by the ratio of diameters of the connected tubes, the ratio of thickness of the main tube to its diameter, and the magnitude of the loads transmitted. Both experience with existing structures and full-scale tests have shown that the direct tube-to-tube joint, without reinforcing plates, is adequate within the usual range of tubes.

British welding standards have been introduced for tubular structures, but the requirements are so strict that often the jointing of branch tubes to main tubes requires a non-standard type of welding technique. According to the Code, fillet welds may be used only for branch tubes whose diameter does not exceed one-third of the diameter of the main tube. In practice, however, the diameter of the branch tube frequently exceeds this figure. In such instances, a butt weld requiring the use of backing

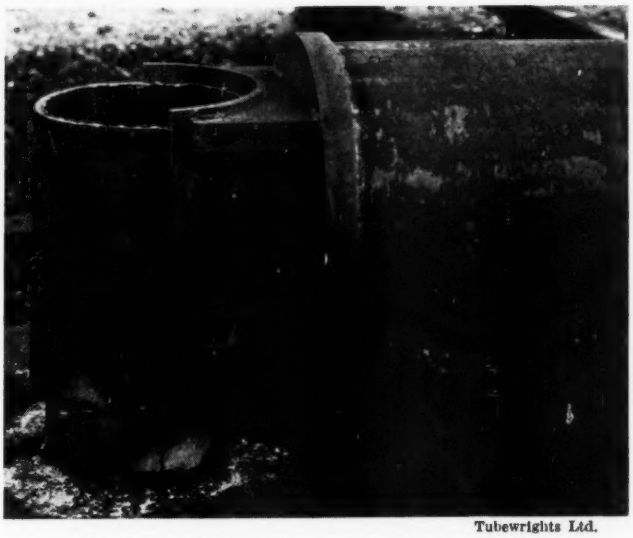
material or a sealing run at the back of the weld is specified. In joining a branch tube to a main tube, however, this procedure is impracticable.

It was therefore decided to adopt a combination of butt and fillet welds. The end of the branch tube was chamfered, leaving a wedge-shaped hollow between the branch tube and the main tube. Skilled welders, using deep penetration electrodes, were then able to deposit the weld into the thickness of the tube and, as an added safeguard, the weld was built up to form a fillet weld on the outside.

Self-Aligning Seats

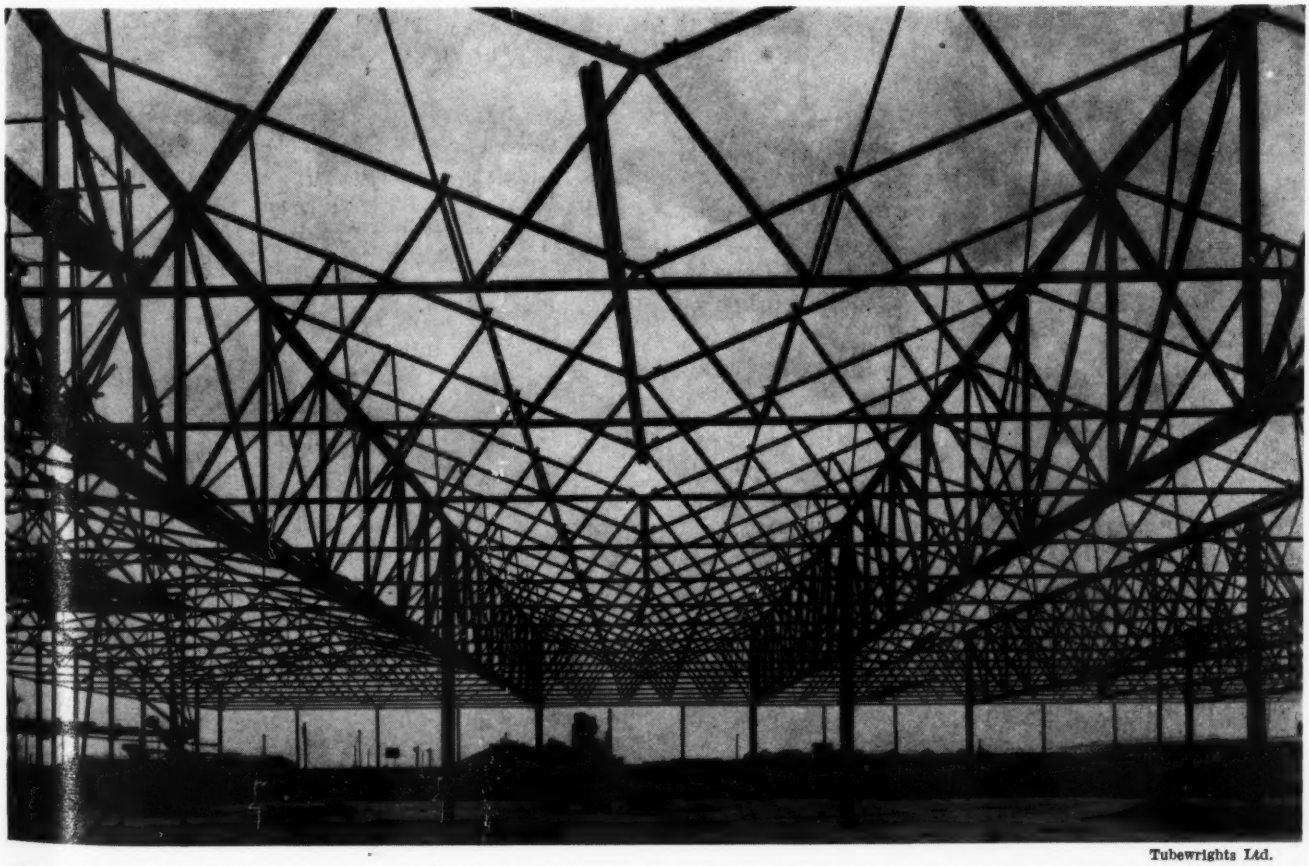
Another new welding technique, used in the erection of the Rotax plant, dispensed with the need for temporary bolts in making the connection between truss and column. This was done by welding semi-circular cleats to the column, which provided self-aligning seats for the trusses and girders. After the assembly was welded, a similar top cleat was added to complete the permanent connection.

The completion of the two factory buildings has demonstrated the potentialities of steel tube as structural medium. The future of this type of structure, however, depends upon the development of improved welding techniques, and upon research to determine the buckling strength of tubes. As yet, no data are available on buckling strength or on the distribution of stress resulting from tube-to-tube connections. For the existing range of tubular structures, adequate practical knowledge has been amassed, and codes of practice have been established. But, as tubular structures pioneer new ground, theoretical investigations will become essential to further progress. ▲▲



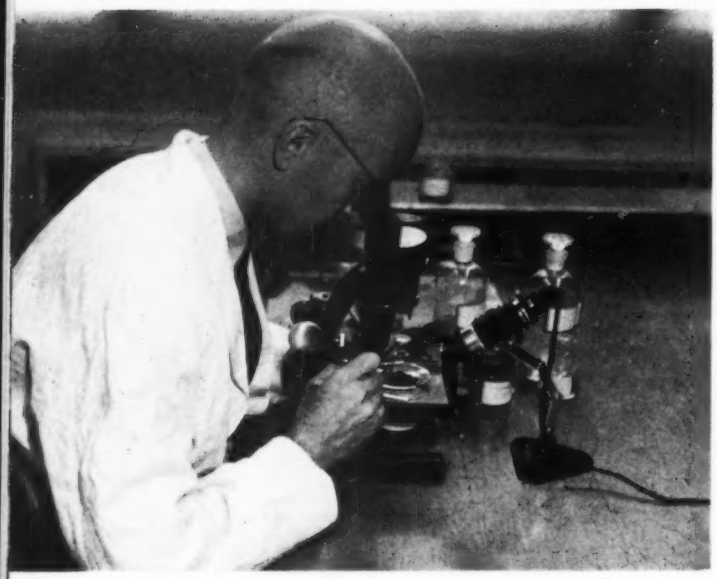
Tubewrights Ltd.

METHOD OF FABRICATING WELDED CAP ASSEMBLIES OF 16-IN. OD MAIN COLUMNS FOR KIRKBY PLANT.



Tubewrights Ltd.

TUBULAR FRAMEWORK FOR MAIN SHOP OF KIRKBY PLANT. STEELWORK FOR THIS PLANT WAS FABRICATED ON SITE.



MICROSCOPIST studies gross structural features of a sample of crushed lignite, using an American Optical Co. stereoscopic microscope. Examination is on raw coal at low magnification (about 30x).

A THIN SECTION of coal is being examined with a biological type research microscope (American Optical Co.). This type of unit permits high power microscopy at magnification up to 2000x.

Coal Microscopy

An Important Research Technique

DR. ALFRED TRAVERSE
Coal Technologist, U. S. Bureau of Mines

Dr. Alfred Traverse held several scholarships and fellowships while receiving S.B. (1946), A.M. (1948), and Ph.D. (1951) degrees at Harvard University. He also studied at Cambridge University, England, 1946-47, as a Henry Fellow. In England, Dr. Traverse became interested in the microscopic structure of coal, and later prepared his Ph.D. thesis at Harvard on some features of the microstructure of a small deposit of lignitic coal in Vermont. He joined the staff of the Charles R. Robertson Lignite Research Laboratory, U. S. Bureau of Mines, Grand Forks, North Dakota, in July, 1951, and since then has been engaged in study of the microstructure of North Dakota and other lignites.

COAL has been the raw material most important to industry since the modern industrial period of civilization began about 150 years ago. Throughout this period, long-stored energy released from coal has turned most of the wheels of industry and commerce, annual consumption increasing from almost nothing in 1800 to hundreds of millions of tons today.

Coal is a fossil fuel, composed almost entirely of chemically altered remains of vegetation that has grown at various times during the last few hundred millions of years. Through the vital process of photosynthesis, these ancient plants have employed the sun's light energy to manufacture carbohydrates from carbon dioxide and water. In addition to simple combustion of coal to obtain this stored energy for power production, industry uses the organic matter in coal as a chemical raw material from which plastics, synthetic rubber, and thousands of other substances can be made.

At present, coal is being severely challenged by petroleum and natural gas as a source of power, but it remains the most plentiful and versatile fossil fuel. It is enormously abundant — many times more so than petroleum and natural gas, the other fossil fuels. Thus, coal seems certain to remain an important fuel, and development of modern chemical techniques for preparing almost any organic substance from it means that products made from coal will have an important place in assuring a bright future for coal-based industry. Although direct synthesis of organic compounds from carbon dioxide and water is a chemical possibility, it is inconceivable that such a process will soon produce economically such abundant quantities of carbon-hydrogen-

oxygen (organic) compounds as are available in the world's huge reserves of coal.

Because of the great importance of coal, basic research on all of its features has long attracted the interest of scientists in many different fields. Chemists have naturally dominated this research from the beginning because nearly all uses of coal depend on chemical reactions.

Unfortunately, many chemists have tended to think of coal as being more homogeneous structurally than it is. Coal is made from plant material of variable chemical composition, selectively altered by processes of natural degradation and deposited under a great variety of conditions. This has resulted in great differences of structure. Such differences among coals are linked with chemical composition and behavior, but a truly meaningful analysis of the chemical features of a material so heterogeneous structurally must be coupled with information about its physical arrangement.

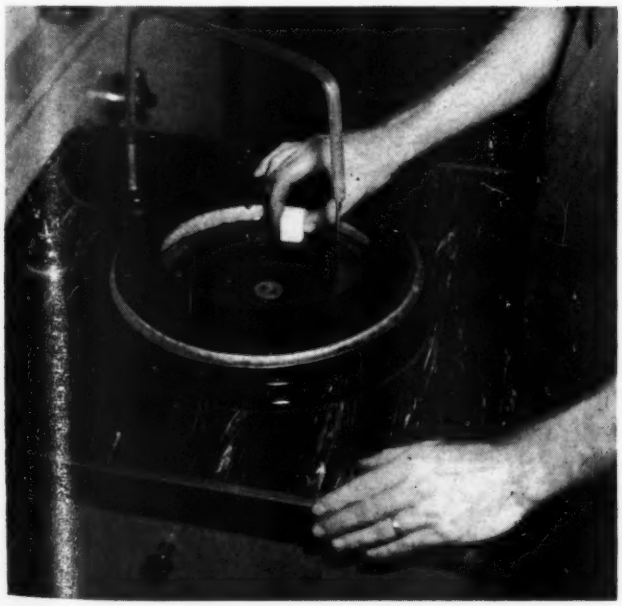
Over a century ago, European scientists discovered that coal can be shown to be a heterogeneous substance when specially prepared samples are observed under the microscope. Since the development of this valuable technique, optical microscopy has been the primary means of studying the structure of coal, although such additional methods as differential thermal analysis, electron microscopy, and X-ray diffraction analysis have recently been employed. In Europe, and especially in Germany, industrial consumers have used microscopy for selecting and identifying coals for special purposes, and for explaining the behavior of coals in such industrial operations as briquet manufacture. Microscopy also is employed as a basic research tool for elucidating many otherwise unaccountable differences among coals.

Much work on the microscopy of coal also has been done in Great Britain, France, and the Netherlands. In the United States, despite great coal resources and production, there has been much less research in coal microscopy than in Europe, and almost all of the work in the U. S. has been done by Federal and State laboratories. However, the contributions made by microscopic research to the development of industrial applications of German coal strongly suggest that the technique should be used more widely by American industry.

Preparing Coal for Microscopic Study

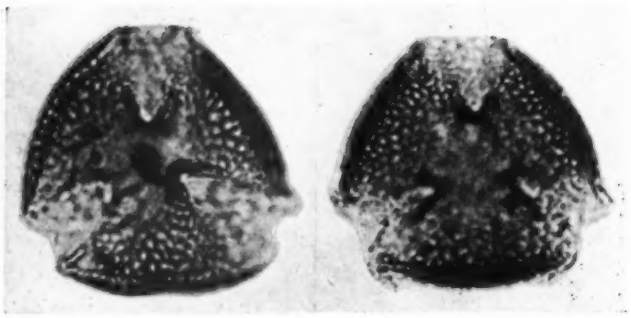
Polished surfaces. Although some rough observations about the structural makeup of raw coal can be made with the naked eye or with only moderate magnification, careful microscopic work requires specially prepared samples and considerable magnification (50-100 x or more). Small blocks of coal can be polished very smooth on one surface and examined by reflected light with special microscopes. Differences in structure of the coal are observable on this surface because of variations in light reflectivity of the structurally heterogeneous components, or because of very slight variations in relief caused by differences in component hardnesses.

There are many refinements of the polished surface method of examination, and much European microscopic work has been done using modifications of this technique. Samples of finely crushed coal or of coal dust can be prepared for reflected light study by mixing the particles with plastics, waxes, plaster of Paris, or some other binding agent, to permit

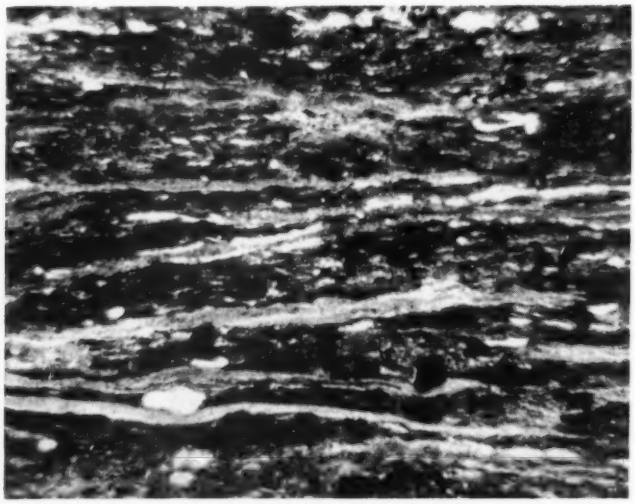


PLASTER OF PARIS block containing small particles of lignitic coal is polished on a Buehler metallographic polisher fitted with a fine grain Carborundum wheel. This is the first step in making a thin section. Similar procedure is used with a solid block of coal.

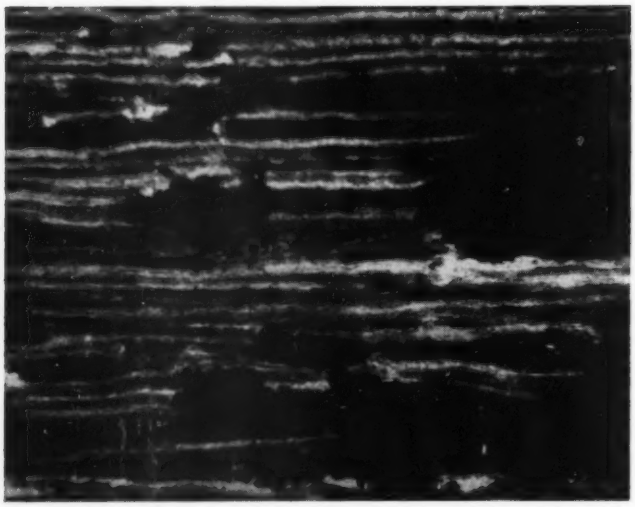
TECHNICIAN POLISHES a block of coal on a very fine grained hone. The polished surface will next be glued to a small glass plate with a thermoplastic transparent glue. Then the coal will be cut and polished away until only a very thin translucent film remains.



POLLEN GRAINS, structurally almost identical. The one on the left was separated by chemical technique from a sample of lignite over 30 million years old; that on the right was collected from a living tree. Both belong to the same kind of tree — Gordonia — which at present occurs only in the South. However, the fossil pollen was taken from Vermont lignite. Magnification: 750x.*



ATTRITAL COAL. Thin section of North Dakota lignite—mostly translucent attritus: macerated plant tissue (grayish), leaf cuticles, pollen, and spores (smaller whitish bodies). There is some opaque attritus (black bodies). Horizontal bands are mostly anthraxylon: leaves and small pieces of woody tissue. Natural colors under microscope: yellow, brown, orange. red & black. Magnification: 110x.*



PYRITE IN WOODY LIGNITE. Photomicrograph of a thin section of North Dakota lignite, cut parallel to the grain, shows typical structure of coniferous wood (anthraxylon), and patches of iron pyrites (iron sulfide). Pyrite is a common mineral constituent of some coals and is opaque (black) in thin sections. Natural colors under microscope: black & reddish-orange. Magnification: 110x.*

preparation of solid blocks containing the particles of coal. A whole block then can be polished as if it were a block of coal. Much the same techniques can be used for coke and coke particles.

Thin sections. Thin films of coal can be utilized for study with a microscope of the biological type, in which light is beamed *through* the specimen (transmitted light). One method of preparing the coal is to use a medical or biological microtome — a special slicing machine with a very sharp, heavy knife that will cut very thin films, 1/5000 of an inch thick or less. These machines can make good slices (sections) of low rank coal although generally the coal must be subjected to considerable preliminary treatment before it can be cut.

Most thin films of coal for microscopic study are made by a variation of the same technique as that used to make polished surfaces. A surface of a block of coal is polished smooth and then fastened with transparent glue to a small glass plate. The coal then is cut, ground, and finally polished away until only a thin film — about 1/2500 of an inch thick — remains on the glass plate. This film or thin section will commonly transmit light and can be studied microscopically.

The variety and beauty of structure observed usually surprise the layman. Perhaps most striking is the variety of colors, which include shades of orange, yellow, red, brown, and black. Sections produced from low rank coal — lignite, for example — are almost uniformly translucent, light orange predominating, with little opaque (black) matter. The colors are of deeper shades the higher the rank of coal. Thin sections of anthracite are almost or entirely opaque.

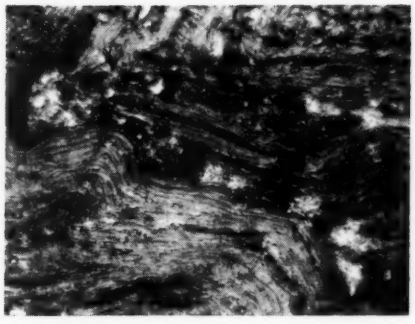
Naturally, it is more advantageous to use the polished block and reflected light method for coals that have a large amount of material that will not transmit light in thin sections. The thin section method, however, has been by far the most popular in the United States. Probably the best idea would be to examine the structure of coal using both reflected light and transmitted light, and some European scientists are employing this technique.

Thin sections also can be made from samples of coal particles or crushed coal. The particles are embedded in a matrix of wax, resin, plastic, or plaster of Paris, and then the resultant block is handled as if it were a block of solid coal. This technique is important because it permits study of thoroughly mixed, representative samples of crushed coal of the sort taken for chemical analysis, and investigation of problems involving coal dusts.

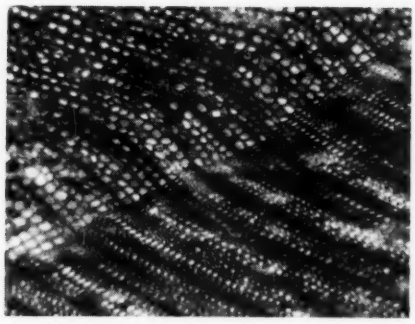
Chemically made preparations. Lignitic, subbituminous, and bituminous coals are susceptible to treatment by various simple chemical techniques, for

*All photomicrographs were made with transmitted light. Thin sections were cut normal to the bedding planes of coal.

ANTHRAXYLON, thin section cut parallel to the grain. Thin section of North Dakota lignite shows the structure of relatively little modified coniferous wood. Principal wood cells can be seen as fine, horizontal lines. The petrographic term for this type of woody structure in a coal is anthraxylon. Natural color of a thin section under microscope: orange-red. Magnification: 70x*.



ANTHRAXYLON, longitudinal section. Thin section of North Dakota lignite shows the structure of somewhat modified coniferous wood, cut parallel to the grain. Some of the wood cells are partly decomposed. The "wavy" appearance in this photo is caused by the distortion of groups of wood cells. Natural color under the microscope: orange-red. Magnification: 70x*.



ANTHRAXYLON, cross section. Thin section of North Dakota lignite shows structure of coniferous wood in a good state of preservation, cut across the grain. Small cells are wood cells from the latter part of one growing season; large cells are wood cells formed in the early part of the next growing season. Natural color under microscope: orange-red. Magnification: 70x*.

example treatment with strong alkali and oxidizing acids. These reagents can selectively break down the structure of the coal, releasing and concentrating certain constituents, which then can be studied microscopically. Lignitic coals are especially amenable to chemical treatment because they are less coalified and more reactive chemically than the higher rank coals.

Parts of plants that were originally waxy can easily be separated from most coals by a combination of treatments that break down the matrix of the coal but do not destroy the waxy fractions. Certain of these waxy structures are the remains of reproductive parts (pollen and spores) of the original plants that contributed to the coal. Another waxy plant part that is abundantly preserved in some coals is the outer coating of certain leaves. Most of the various waxy plant remains in coal are very distinctive structurally and can be identified as to nearest living relative or compared with other fossil forms if they are from extinct groups of plants. These so-called microfossils are usually very tiny and must be studied at considerable magnification.

This type of investigation has two principal purposes. First, the combination of such fossils in a given coal bed is usually characteristic of that bed, and if an extensive job of cataloguing is done, coal beds can be identified and correlated by the content of these tiny fossils. This is often important in mining practice where a number of coal beds are encountered. If identification has been accomplished, information about the characteristics of a new coal bed frequently can be derived from what is already known about an established coal bed in another mine in the same field.

The second purpose of identifying microfossils from coal is to obtain knowledge about the plants in the original vegetation that contributed to the coal and about the conditions under which the material was deposited. This sort of information is sometimes valuable in explaining the behavior

—Continued on page 78

TABLE 1 — GROSS PETROGRAPHIC CONSTITUENTS OF COAL

U. S. Bureau of Mines (Thiessen) Name	*Microscopic Characteristics U.S.B.M. Constituents*	*Most Nearly Equivalent German Name*
Anthraxylon	Relatively large pieces of altered tissues, such as wood, bark, seeds, and roots, with cellular structure. Translucent in thin sections.	***Vitrit.*** (Essentially identical with anthraxylon.)
Translucent attritus	Masses of very small particles of tissues, such as the above or derivatives of them; also includes pollen and spores and other particles of waxy matter. Translucent in thin sections.	***Clarit.*** (Approximates translucent attritus in a general way only. Clarit includes fragments of anthraxylon and other materials that would not be included in translucent attritus.)
Opaque attritus	Masses of derivatives of plant tissues or small particles of plant tissues, all opaque in thin sections; also some cellular tissues that are opaque but are not typical fusain (see below).	***Durit.*** (Approximates opaque attritus in a general way only. Durit includes matter that is not opaque, such as pollen and spores.)
Fusain	Cellular, usually woody, tissues that are completely opaque in thin sections except for the spaces in the cells and between cells. These spaces are often filled with mineral matter.	***Fusinit.*** (Essentially identical with fusain.)

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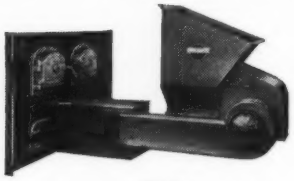

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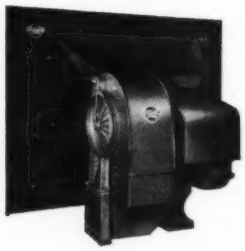

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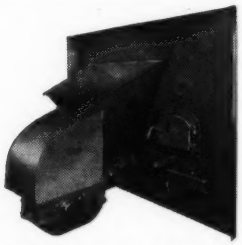

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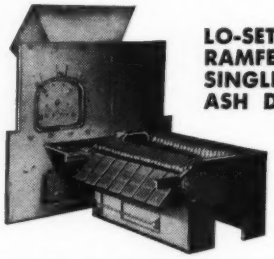

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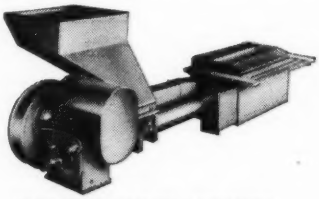

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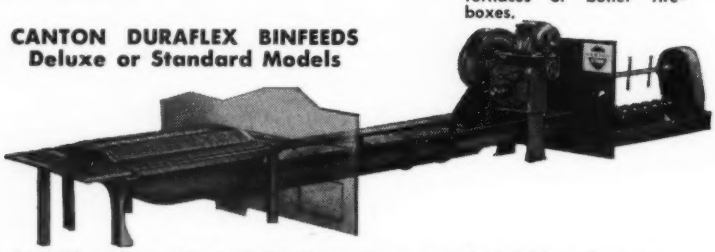

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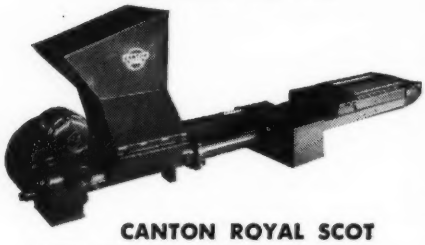

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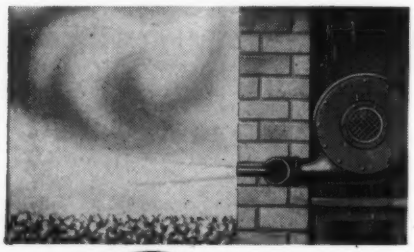
COAL ENTERS EXPOSED END



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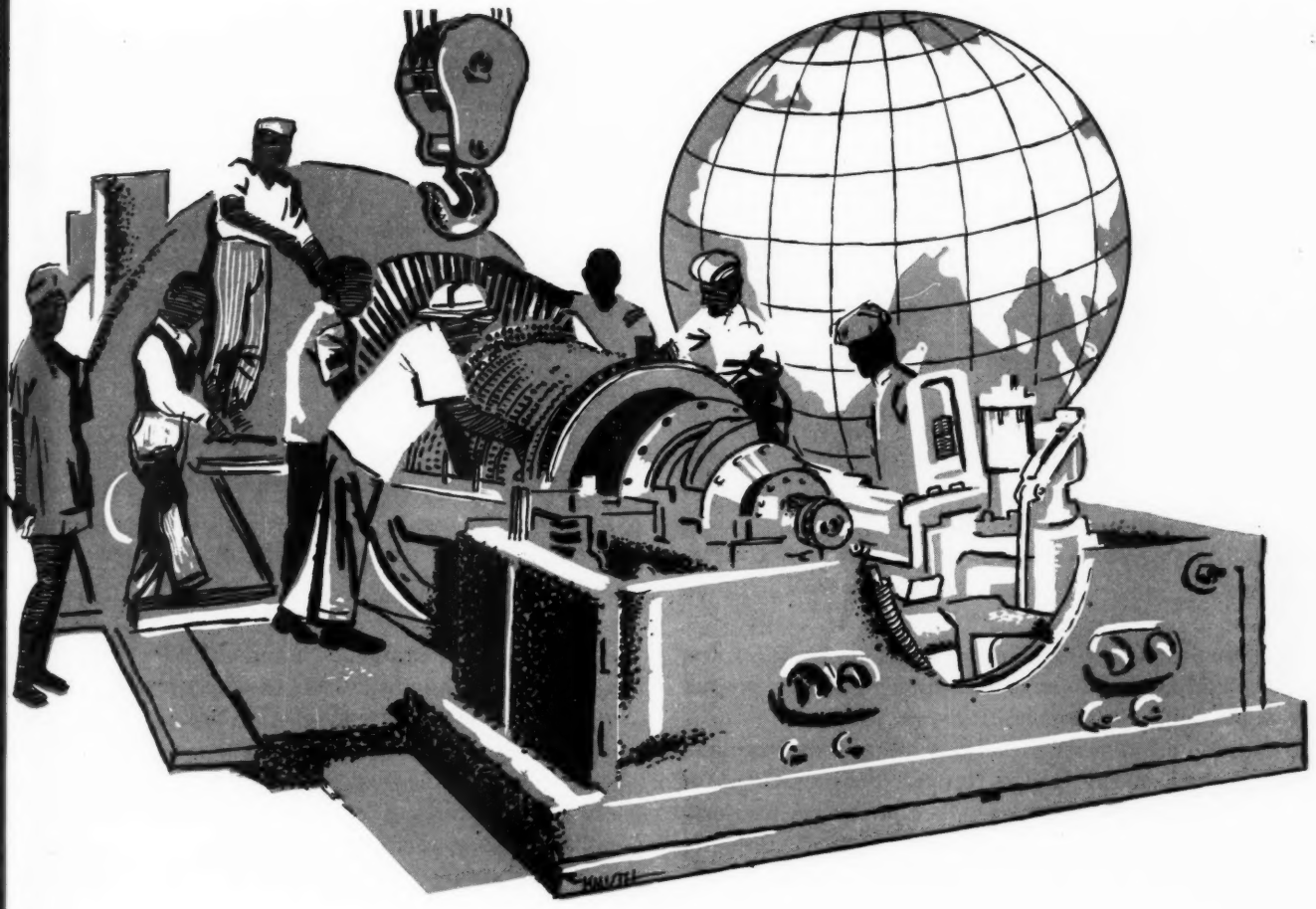


Are Foreign Projects Foreign to You?

MILTON TUCKER
Department of Specifications
Kuljian Corporation

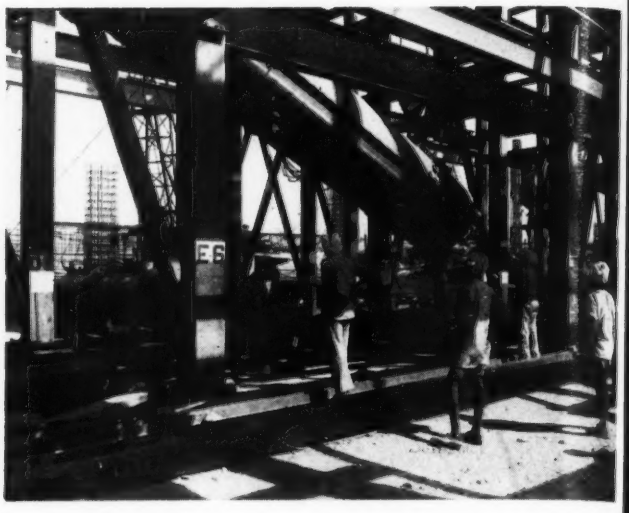
CE exclusive

THERE ARE CONSULTING ENGINEERS in America who do not share a rather common belief that Americans have a world-wide monopoly on engineering know-how. One of these engineers who believes that foreigners are making worthwhile contributions to engineering is The Kuljian Corporation. This Philadelphia firm has an enviable record of large-scale engineering throughout the world--as well as in the United States.

Kuljian's success with foreign projects is due largely to a recognition of the foreign client's experience with certain materials and methods successfully used in his own country. Kuljian has demonstrated that an understanding attitude toward the client and a sympathetic approach to the problems of his land pay good dividends—not only in good will but in more tangible repeat orders. Such engineering diplomacy pays far better than an attitude of superiority and supposed sophistication.

The greater the degree of understanding of local customs, methods, and traditions, and the greater the utilization of any of these that contribute to good engineering, the greater will be the speed of construction and the smoother will be the progress toward final completion. This is especially true if large amounts of local labor are to be used in construction. And, finally, when the job is completed, the new owner will point with justifiable pride to the project in which he, himself, took an active part. Thus, the foreigner has retained his self respect, and the American consulting engineer has earned the good will of the people.

The Kuljian organization likes to think of itself as a "slide rule diplomat." This is because of its ability to design a large project for a foreign land in such a way that native labor can be organized



ON THIS POWER PLANT INSTALLATION IN INDIA, LABOR WAS PLENTIFUL. IT WAS FOUND THAT IT WAS MORE ECONOMICAL TO USE MORE MANUAL LABOR AND FEWER MODERN MACHINES — QUITE THE CONTRARY OF U. S. PRACTICE.

into contented groups and trained to perform the many and varied tasks of building their own project —and finally running it.

Fundamentally, the Kuljian philosophy is this, "When in Rome do as the Romans do," provided, of course, what you do is sound engineering, economically wise, and contributes to morale.

Take, for example, the new Bokaro power plant recently engineered and constructed by Kuljian for India at a cost of $35,000,000. This is the largest steam power plant in the Far East and the first high pressure plant in that part of the world. The work of construction was done almost entirely by local labor. Only four Americans were brought into India to organize the construction work and supervise this huge project.

This Bokaro Thermal Power Station is but one unit in a courageous program envisioned by Prime Minister Nehru to improve the great Damodar Valley, north of Calcutta. In addition to the thermal-electric station, the program includes hydro-electric works and flood control which provide ample cheap power during the monsoons for manufacturing, and the control of water eliminates damage from devastating floods and increases agricultural production through irrigation with the stored water. All this is strengthening the hearts and minds of these people and giving them courage to withstand aggression from without—and within!

Before the engineering of the Bokaro Station had progressed very far, a group of young Indian engineers was brought to Kuljian's headquarters, in Philadelphia, for the sole purpose of exchanging engineering information and know-how. These Indian engineers helped solve many problems concerning local labor and materials. From them, Kuljian learned that in India, where labor is cheap and plentiful, some methods which appear to be primitive, time-consuming, and inefficient are actually the most suitable. A total of over 4000 coolies were used for the hundreds of operations performed during the construction of the Bokaro Station. In excavating the site, over 600 coolies were employed, with baskets balanced on their heads. This ancient method of moving earth and rock was actually more economical than would have been the use of modern labor-saving equipment shipped from the United States.

Moreover, the exterior walls were constructed of local stone, laboriously and painstakingly cut by hand by native stone cutters. The finished product was excellent and far less expensive than more modern materials meeting Western standards. First quality concrete blocks were manufactured on the site by natives and used for back-up and other concealed masonry.

On this project it might be said that Kuljian acquired the know-how of a foreign land—from Indian engineers. In exchange, Kuljian familiarized the visiting Indian engineers with the layout and functions of the power plant they were to manage and trained them in its operation. These engineers are now back in India helping to produce the low cost electric power which has long been needed to raise the standard of living in their land.

Kuljian has successfully engineered many other projects around the world—in Sicily, Venezuela, Chile, Belgian Congo, Mexico. On every project local materials and construction methods were investigated, and whatever was considered sound engineering and good economy was incorporated into the work. Power plant equipment and some other manufactured materials, naturally, are made in the United States and shipped to the site.

It is not surprising that a concern known around the world for its engineering should attract to its Philadelphia office some of the best engineering brains of nearly every nationality. Here at Kul-

jian's are many native born Chinese, Indian, Czechoslovakian, Armenian, Greek, German, Iranian, Spanish, and Egyptian engineers. Some of these came to the States as exchange students and later apprenticed at Kuljian's and became naturalized. Others received their degrees abroad at recognized engineering schools in Switzerland, Germany, and Austria before coming to America.

The same realistic attitude which Kuljian displays toward a client in a foreign land is in evidence when foreign born engineers apply for admission to the organization. Applicants are questioned only as to their engineering education and experience, and their loyalty to their land of adoption. As a reward for this unprejudiced attitude toward the foreign born, Kuljian has gathered together a cosmopolitan and versatile engineering team. These men fit naturally and easily into the organization and make a tangible contribution to "slide rule diplomacy."

Foreign Engineers

Proof of the fact that these foreign born now at Kuljian's have made good is seen in their accomplishments here in America. Many are well known in engineering circles. A number of them have become authorities in their own particular phase of engineering. Some are old-timers who have had such responsibilities as designing and illuminating some of America's great bridges, or laying out high speed transit systems for large cities, or designing the electrification of our busiest railroads.

An outstanding example is Nejdeh H. Aslanian, who immigrated to America from Iran, in 1945, on a student's visa. At engineering and architectural schools he made brilliant records. Later, Aslanian joined the Kuljian organization as a structural designer at a time when Kuljian was engaged as Architect-Engineer on a $160 million program for the construction of double-cantilever hangars to house bombers of the United States Air Force. To save engineering costs for the government, these mammoth hangars were standardized, and since they might be built anywhere in the United States and strategic locations abroad, they required foundations to suit all types of soil conditions. In addition, they had to be designed to withstand hurricane winds and earthquake forces as well as varying roof loads. Mr. Aslanian assisted in finding the best solution to many of these unusual engineering problems.

In addition to these standard hangars, Mr. Aslanian played an important part in the design of the world's largest maintenance and repair hangar at Kelly Air Force Base, Texas. This hangar has a total roof area of 23.5 acres (twice the size of the second largest hangar in the world). In recognition of his outstanding contribution to the defense of the United States, and to permit this brilliant young engineer to remain in this country, President Eisenhower recently signed into law a special bill cutting immigration red tape and granting Mr. Aslanian permanent residence in the United States.

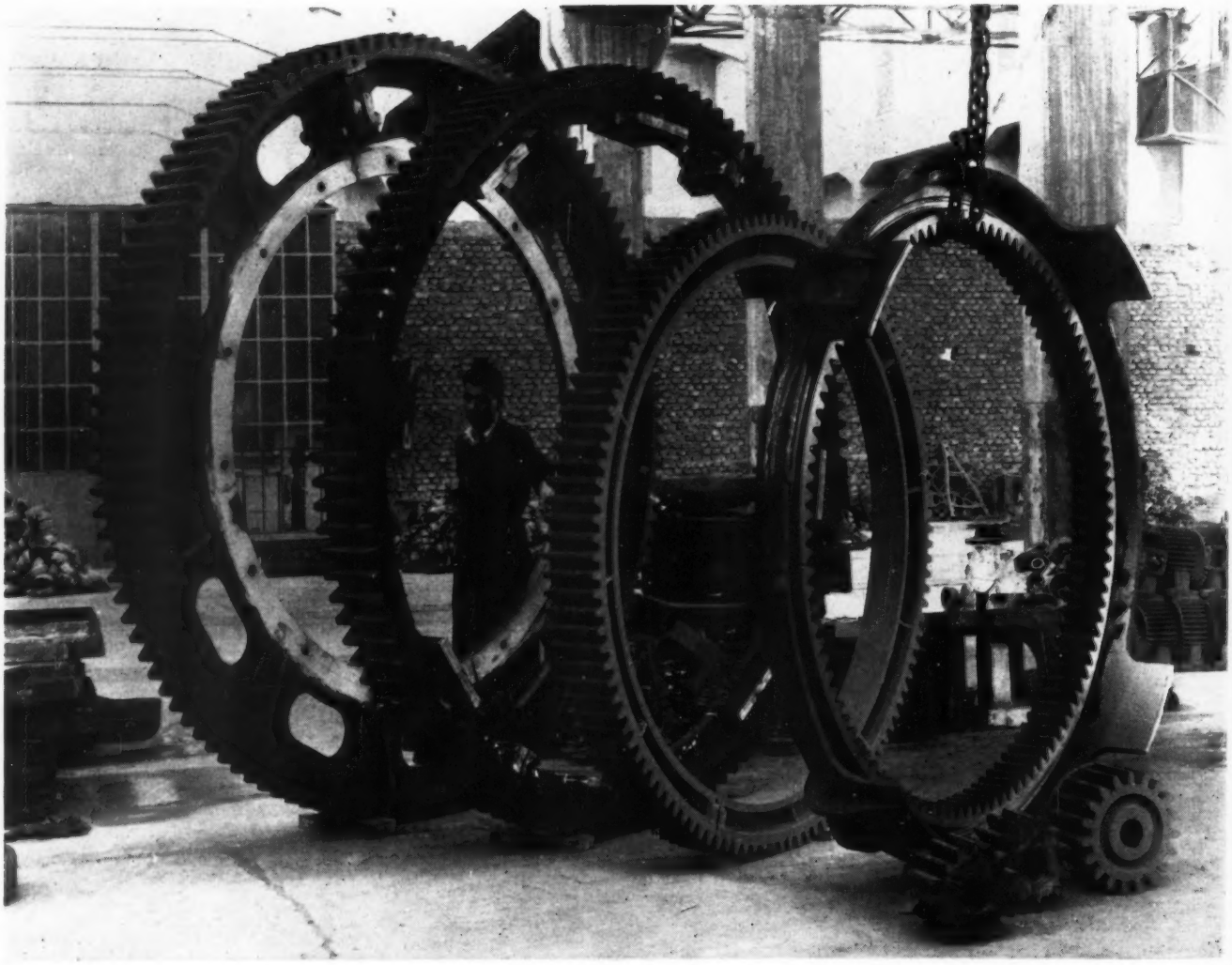
Recently an elaborate birthday card was given to one of Kuljian's electrical engineers. On it appeared "Happy Birthday" written in sixteen different languages — each the native tongue of a member of the Kuljian organization.

One might draw the conclusion that Kuljian's office is a modern Tower of Babel. Nothing could be farther from the truth. Naturally, one can detect a foreign accent now and then, but interwoven with this cosmopolitan woof is a strong warp of American parentage of many generations back. For example, the executive vice president, James L. Cherry, comes from old Pennsylvania stock and for several years taught architectural-engineering at Pennsylvania State University. Likewise, Arthur H. Kuljian, son of the founder, and Vice-President in charge of Engineering, was born and educated in America. Moreover, in the Department of Specifications (where a thorough knowledge of the English language is absolutely essential for the preparation of unequivocal contract documents) the head of the department is of pure English stock, ten generations in the New World.

Recently a test was made to determine the size of the English vocabulary of Aswath Maddagiri, a young engineer from India, who has been with Kuljian for several years. This test was purely for amusement and to try out a newly discovered method of determining the size of one's working vocabulary. The result was amazing — Mr. Maddagiri had a working English vocabulary of at least 25,000 words! This is well above the average for so-called "educated" Americans who are not connected with the teaching or writing professions. However, the high rating was not surprising when it was learned that he has been studying English since he was eight years old and holds degrees in Aeronautical as well as in Mechanical, Electrical, and Civil Engineering.

World as a Market

To sum it up, Kuljian Corporation has found that engineering knowledge is not strictly a product of the industrialized Western nations. Not only does the rest of the world offer an attractive market for engineering work, but these countries also supply men who, when properly trained, are capable of becoming outstanding professional engineers. Furthermore, native labor and native construction methods frequently prove best for the conditions under which they are applied. On foreign projects in the less industrialized nations, it is necessary for American firms to learn as well as to teach. The result is an increased standard of living for the peoples of these lands and improved public relations for the United States wherever we build throughout the free world. ▲▲



GEARS MADE OF DUCTILE IRON OFFER CONSIDERABLE SAVINGS IN WEIGHT WITH SERVICE LIFE AT LEAST DOUBLED.

Properties and Applications of Ductile Iron

STAFF REPORT

TO MOST ENGINEERS ductile iron is a new material, but to many foundry men, this is far from true. Since the announcement of the development of this material at the meeting of the American Foundrymen's Society in Philadelphia, in May 1948, there has been a constant flow of publicity in the form of technical articles in the metals trade press, and there has been scarcely a meeting of a technical society in the metals field at which a paper has not been presented on the subject. The result is that metallurgists and foundrymen are reasonably familiar with ductile iron and the production of it. On the other hand, many engineers are totally unfamiliar with its physical properties and its varied fields of application.

Ductile iron is not just one single material. Like steel, it can be produced with a wide range of properties. Generally, this family of properties places it somewhere between gray cast iron and steel, thereby filling a previously existing void in ferrous materials. Table 1 shows mechanical properties of commercial heats of ductile iron, and it can be seen that so far as tensile strength is concerned, it can vary from a low of about 60,000 psi in the annealed condition to a high of 175,000 psi when quenched and drawn. Gray cast iron has a tensile strength of about 25-35,000 psi, while steel

runs from 75,000 to well above 200,000 psi for special alloys of the material.

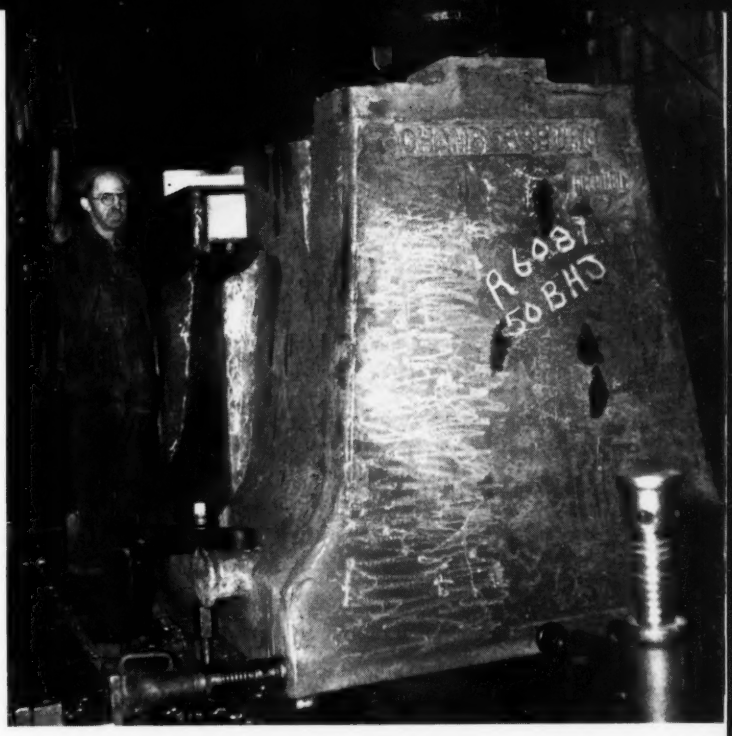
It is not only in strength that ductile iron bridges the gap between gray cast iron and steel. Ductility is obviously involved. Gray cast iron is completely lacking in ductility so far as its practical application is concerned. Steel is quite ductile. However, steel is difficult to cast, and when intricate shapes are required along with strength or ductility, designers resort to forged or otherwise hot or cold worked shapes, or components assembled by welding. Ductile iron can be cast into all the intricate shapes and patterns which can be cast in gray iron, yet its ductility and strength make it suitable to many applications in which cast iron would be too brittle or weak.

Ductile iron has another characteristic which is frequently advantageous. It has a wear resistance at least equal to cast iron—which is quite good—and is very machinable as well. In fact, it machines about as well as gray cast iron of the same hardness and perhaps two to three times better than steel. A turning test with Carboloy tools shows that ductile iron in the as-cast condition has about the same machinability as low-strength gray iron—and is superior in the annealed state. Ductile iron develops longer chips than cast iron, and machining produces a finer surface, resembling steel.

Graphite Formation

These properties of ductile iron are, generally speaking, the result of the way the free carbon is formed in the ferrous matrix. The photo-micrographs show the familiar pattern of the free graphite in gray cast iron. It can be seen that the weak graphite forms a semi-continuous network of flakes. On the other hand, the free carbon in the ductile iron is in the form of small spheres (this material is often referred to as spheroidal graphite iron, or nodular iron) and these spheres are not connected one with the other. Since there is no network of graphite, the resulting material is much stronger and more ductile than cast iron.

Ductile iron is produced by adding a small amount of magnesium into heat of typical gray iron. The base iron should be low in sulfur, manganese, and phosphorus, and can have a silicon content of 1.0-2.00 percent. The result might be called a high silicon steel containing free graphite in spheroidal form. The percent of silicon has a considerable effect on tensile strength and elongation, but the amount of carbon in spheroidal form does not seem to affect the strength to any considerable extent.



THIS 50-TON FORGING HAMMER ANVIL BLOCK WAS CAST FROM DUCTILE IRON WITH GOOD RESULTS.

There are in this country approximately 100 companies licensed to produce ductile iron (licensed by International Nickel Company, holders of two patents on the process) and about 160 more licensees in 22 other countries. Casting problems from foundry to foundry have varied, but it is rather generally agreed that at this stage, careful control of the heat is required to produce a good material. In June, 1950, *Steel* made a survey of ten foundries producing ductile iron on a commercial scale, and the comment was varied. One superintendent of a foundry reported trouble achieving consistent quality so that he gave it up as a bad job. On the other hand, others were continuing their work, and seemed pleased with the progress they had made.

Specifying

Today, the consulting engineer can specify ductile iron with reasonable assurance that his specifications can be consistently met so long as he keeps within the stated range of physical properties. For example, it is impossible to get the highest strength

TABLE 1—MECHANICAL PROPERTIES OF COMMERCIAL HEATS OF DUCTILE IRON

Condition	Yield Strength lb per sq. in.	Tensile Strength lb per sq. in.	Elongation Percent	BHN Hardness
Annealed	40-50,000	60-70,000	15-25	150-190
As-Cast	50-85,000	70-110,000	3-15	170-260
Normalized (air cooled at 875 C)	75-90,000	110-130,000	6-10	225-275
Quenched and Drawn	85-140,000	110-150,000	2-9	240-325

TABLE 2 — EXAMPLES OF DUCTILE IRON APPLICATIONS

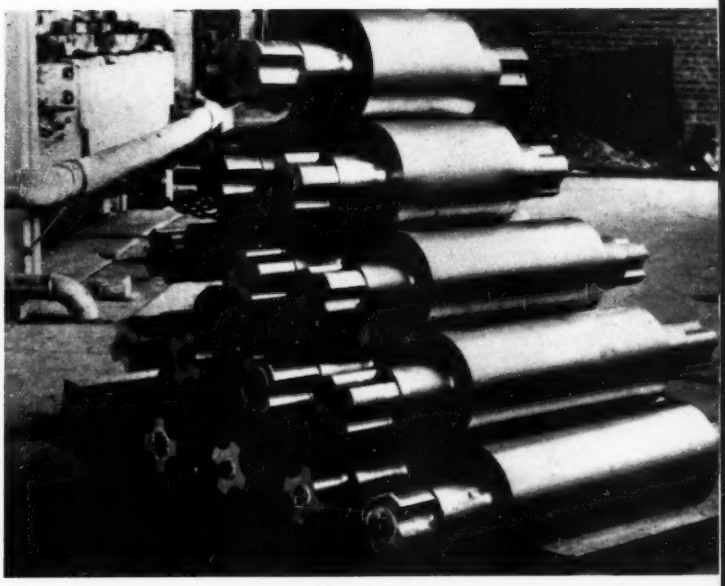
Part Name	*Application*	*Specification*	*Material Replaced*	*Advantage Gained*
Compressor head	Reciprocating compressor	60-45-10	Cast steel	New design made possible
Cylinder head, piston, rod end, and manifold	Hydraulic truck hoists	60-45-10	Malleable iron	Higher strength, less processing time, improved machinability
Crown bevel gears	Paper pulp beater drive		Steel and cast iron	Over 2 years service against 6 mo for other materials
Plow shares	Agricultural equipment	80-60-03 with chilled cast working face	Forged steel and chilled iron	Still serviceable after plowing 25 acres vs. life of 8 acres for steel
Special piston, (splined)	Special motor	Oil quenched and drawn to 248 BHN	Mn-Al bronze and steel, silver plated	Wore only half as much as Mn-Al bronze piston
Valve bodies and pressure reducers	High pressure natural gas lines	60-45-10	Cast steel	Fabricated components replaced by ductile iron casting — improved machinability
Pistons	Railroad diesel engines	80-60-03	Cast aluminum	Superior heat and wear resistance
Shafts	Generators	80-60-03	Alloyed cast iron & forged steel	28% cost reduction over steel higher strength than cast iron
Upcoiler rolls	Receive and coil cold rolled steel strip	60-45-10 flame hardened	Steel & bronze	Redressing required 1/4th as often
Heading die	Heading 20mm brass cartridge cases	60-45-10 Surface hardened	Hardened tool steel	Serviceable after 875,000 pieces. Tool steel dies made only 60,000 pieces
Butane manifold valve body	Metering butane at high pressure	60-45-10	Cast steel and malleable iron	Superior pressure tightness and machinability
Camshaft drive gear	Labeling machines	60-45-10	Cast steel and high strength cast iron	Replaced materials averaged 2 mo service. Ductile iron 23 mo with negligible wear
Main bearing support	YJ-65 sapphire jet engine	Alloyed with nickel (austenitic)	Aluminum forging	1200 hrs machining time eliminated. Cost reduced
Pouring troughs	Continuous casting of aluminum ingots	60-45-10	Gray iron	Improved heat resistance. Outlasted gray iron 10 to 1.
Furnace grates	Greenawalt sintering furnace	80-60-03 60-45-10	Gray iron	Lasted over 10 times longer than gray iron
Furnace doors	Forging furnaces	80-60-03 60-45-10	Gray iron	Average life is 300 days vs. 6 days for gray iron
Die shoe	3000 ton press	80-60-03 60-45-10	Cast steel	Improved machinability and availabilty
Steel mill rolls		Steel & alloyed gray iron		Outlasted both materials by more than 3 to 1
Throat liner	Rotary cement kiln discharge end	80-60-03 60-45-10	Stainless steel	Availability & reduced cost — lasted over 2 years
Sprockets and cleaner blades	Driver and idler sprockets and cleaner blades		Cast alloy steel (sprockets) and gray iron (blades)	Improved resistance to wear and shock
Frames	Hand clamps	60-45-10	Forged steel and malleable iron	Twice the strength of both replaced materials and superior machinability
Axle pivot housings	Road building earth compactor	60-45-10	Fabricated steel & malleable iron	Can be made as a single casting. Superior machinability.
Tank turret lock assembly	Army ordnance tanks	60-45-15	70,000 psi cast steel	Improved machinability and availability.
Burner support rings	J-48 jet engines	80-60-03	Cr-Mo-Cu gray iron	Superior heat resistance
Tool shanks	Carbide tipped lathe tools	60-45-10	SAE 1075 annealed cold drawn flat bar stock steel	Extensive milling eliminated. Superior damping permits greater tool overhang.
Tire molds		60-45-10	Aluminum	Improved fidelity in finished tires. Finer casting tolerances and surface finish.
Glass molds and plungers	Molding fine glassware	60-45-10	Alloyed cast iron	Finer surface and improved heat resistance
Frames	Roflex liquid level gages	60-45-10	Malleable iron	Better machinability
Industrial fan hubs	Large industrial fans	60-45-15	Cast steel and malleable iron	Machining rejects reduced. Cut machining time. Less tool breakage.

in combination with the greatest ductility. There is also a difference in the properties of the material in the as-cast and in the annealed state and much better results have been achieved by annealing thin-walled and small castings than in producing them in the as-cast condition.

Successful Applications

Most consulting engineers will be more interested in the successful applications of the materials than in the metallurgical production problems or the difficulties of individual foundry men. One application in which much interest has been generated is for ductile iron pipe. It is best suited for applications in which cast iron pipe has been found lacking in ductility and strength. For example, sea-going tankers carry with them a supply of cast iron pipe. It has been found that the jolting and the stresses and strains imposed on this piping at sea is too much for cast iron. Its brittleness is a distinct disadvantage, and some ductile iron pipe has been used successfully to replace it. There are also some cast iron water pipe installations that have not stood up well because of heavily trafficked streets and the resulting vibration and heavy compacting of the soil. Ductile iron is particularly attractive for installation in areas subject to earthquake damage. Also, in cold areas the freezing and thawing of soil has built up a record of cast iron failure, and there is no question but that rough handling by pipe crews may break enough cast iron pipe to make the higher first cost of the more ductile material economic in some installations.

It will undoubtedly be possible to utilize the superior mechanical properties of ductile iron over gray iron and thus use thinner walled ductile iron pipe. This should permit the price per length of pipe to be competitive with the current price of cast iron pipe. Foundry problems may be encountered in casting thinner walled ductile iron pipe but these problems undoubtedly will be satisfactorily solved by the producing foundry. A further advantage of this thin walled pipe would be its reduced shipping cost because of its lower weight. Of course, ductile iron pipe is now cast to normal pipe thickness with no difficulty.



A FRENCH COMPANY SUCCESSFULLY MAKES DUCTILE IRON ROLLS FOR FINISHING TO SPECIAL PROFILES.

Ductile iron pipe can be welded (as can all ductile iron castings) using a high nickel-iron rod, and in one test, the bursting pressure on 8-in welded pipe was 5,300 psi for ductile iron against 2,400 psi for gray iron. Ductile iron fittings have been given extensive Underwriters Laboratories tests, and have been approved.

Currently, ductile iron pipe is being cast in the United States in 4-in to 12-in diameters and 18-ft lengths. In France, this pipe is being cast in diameters as small as 1-in.

More experience has been had in the casting of other shapes in ductile iron than in the casting of pipe. Cylinders for hydraulic presses and cylinder heads for diesel engines and compressors are examples of applications where ductile iron has made a good name for itself. Pump casings and oil well equipment have also been satisfactorily cast.

Cooper-Bessemer had their own foundry licensed to cast ductile iron, and they have been having excellent results. They have, for over two years, been casting a 2400 lb compressor body in ductile iron with a tensile strength of 76,200 psi and a test elongation of 5 percent. The steel castings previously used had a tensile strength of 72,500 psi with an elongation of 23.5 percent. By producing the ductile iron castings in their own foundry instead of buying the steel castings, Cooper-Bessemer has been able to reduce the price of the complete compressor cylinder by 20 percent. This same company has also used ductile iron for pistons. Indi-

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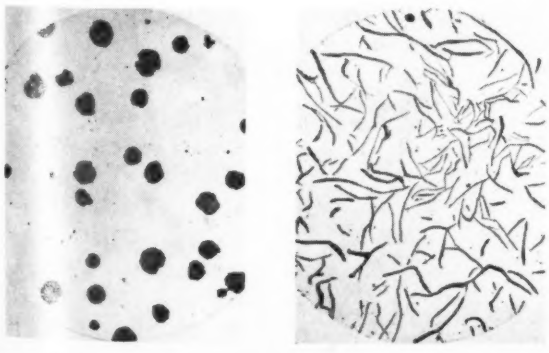

FLAKE GRAPHITE (RIGHT) APPEARS IN GRAY IRON WHILE DUCTILE IRON HAS SPHEROIDAL GRAPHITE.

An engineer from Quinn & Feiner, Refrigeration and Air Conditioning contractors, shown checking the largest reciprocating compressor installation in the East.

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The Folded Plate — A Lighter, Stronger Concrete Roof

CE exclusive

MILO S. KETCHUM, Partner
Ketchum and Konkel

M. S. Ketchum, a civil engineering graduate of the University of Illinois, served as assistant professor of structural engineering at Case School of Applied Science for seven years. Next, he became associated with Floyd Brown and Associate, remaining with the firm until 1945 when he moved to Denver and opened his own office as a consulting structural engineer. Now known as Ketchum and Konkel, the firm has designed several outstanding structures, including the thin shell concrete building for H. W. Moore Equipment Company, described in this article.

ALTHOUGH reinforced concrete is not generally considered for long span industrial roof construction because of the heavy sections and the costly beams and columns required, it can be made practical by using thin sections shaped to form a frame. A particularly economical design of this type is the folded plate.

In the folded plate design, concrete slabs, constructed so as to join at angles to each other, act as plate girders tilted on their sides. An interesting example is a building constructed for the H. W. Moore Equipment Company in Denver. The roof of this building is designed as a concrete slab in the short direction, and as a concrete girder in the long direction. Two distinct roof contours were used. Over the office area, a series of individual Z-shaped units were arranged so as to provide a clerestory window between adjoining segments, while over the shop area, a series of connected V-shapes were used.

In comparison to concrete beams, these structures are quite thin. The Z-shaped folded plates are 4 inches thick, and span 75 feet with an overhang of 22 feet on each end. The V-shaped plates are 6 inches thick, and they span 80 feet in the long direction and 18 feet, from valley to ridge, in the other direction. Also, they are designed to carry two 15-ton cranes hung from the concrete slab in each bay without long bridge cranes — one of the virtues of folded plate construction.

Analysis of this type of construction is not diffi-

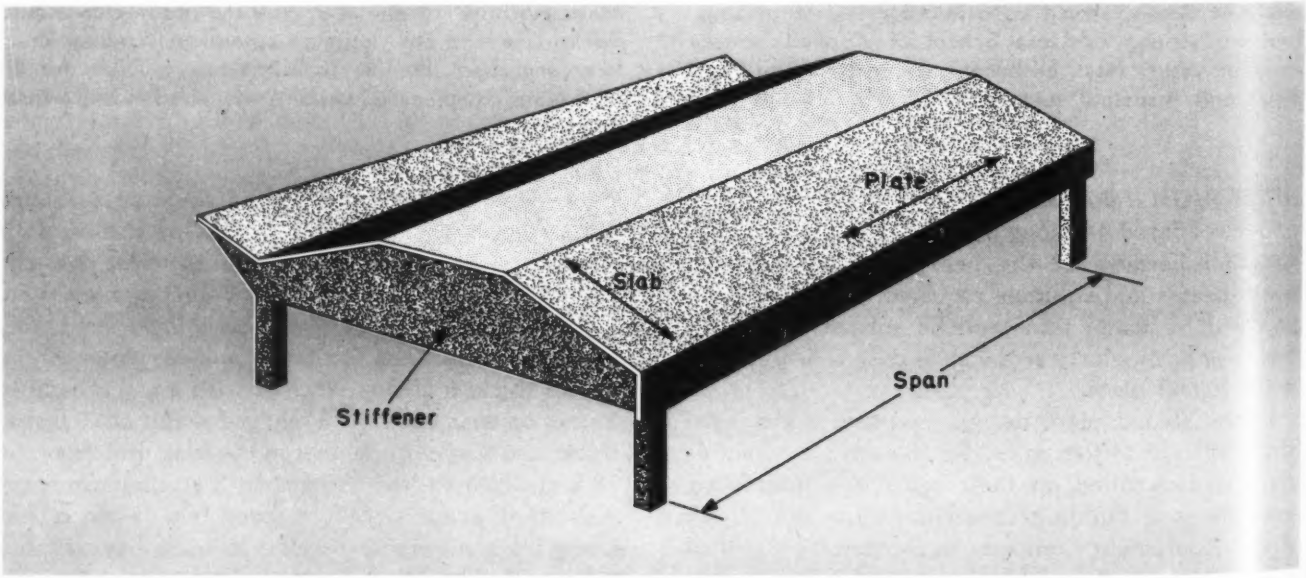
Z-PLATE ROOF SECTIONS, USED IN THE OFFICE AREA, WERE POURED ALMOST ENTIRELY USING MOVABLE FORMS.

cult, since the folded plates may be treated as common beams. The procedure is described in a paper, "Hipped Plate Construction," by George Winter and Minglung Pei, *American Concrete Institute Journal*, Jan. 1947. The structure is first designed transversely as a slab. The live and dead loads are divided into components along the slope of the plates, and the forces are computed.

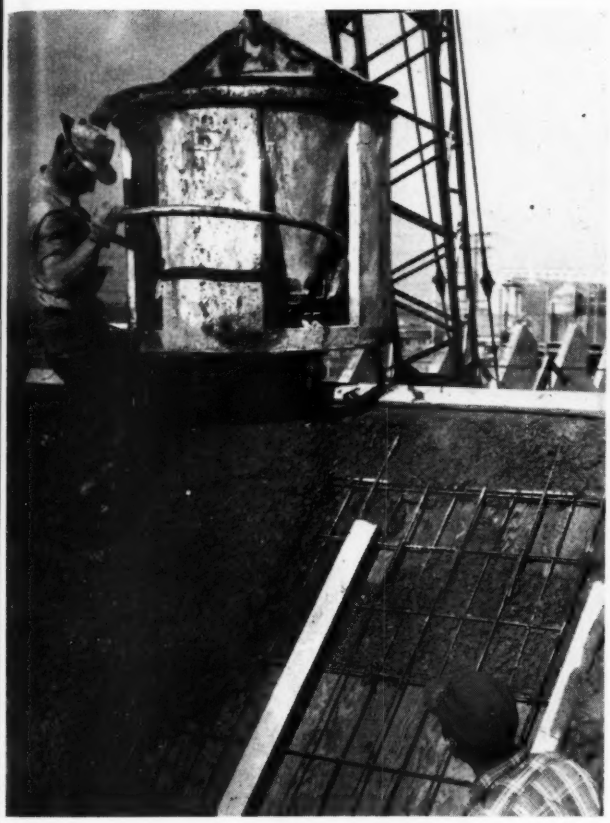
The maximum economical span of a slab is limited to about 20 feet, but the shell may be made up of a number of segments combined to form an infinite variety of shapes to meet functional and aesthetic requirements. The slab may even be combined to approximate a curved shell, if desired. There should be a short segment at each end, however, cantilevered so as to reduce the maximum bending moments in the slabs.

The stresses in the sloping plates are then determined as for an ordinary plate girder, and a correction is made so that stresses in abutting plate girders are the same. Additional reference to the correction of transverse moments for deflection of the plates can be found in a paper by Ibrahim Gaafar, "Hipped Plate Analysis Considering Joint Displacements," Proceedings ASCE V. 79, No. 182. This correction is similar to that caused by sidesway in rigid frames.

At points of support, the plates must be stiffened



IN DESIGNING A FOLDED PLATE CONCRETE ROOF, THE SHELL IS TREATED FIRST AS A TRANSVERSE SLAB AND THEN AS A LONGITUDINAL PLATE GIRDER. STIFFENERS AT THE ENDS TAKE LATERAL THRUSTS OF THE GIRDERS.



CONCRETE OF PROPER CONSISTENCY IS EASY TO PLACE—DOES NOT SLIDE DOWN STEEP ROOF SLOPE.

REINFORCING FOR Z-SHAPED ROOF SHELLS ASSISTS IN HOLDING THE CONCRETE ON THE STEEP SLOPES.

by a cross girder so as to transfer the loads into the columns. There also may be very large thrusts accumulated by the slanting plate girders. These thrusts must be held by steel ties or by rigid frame action of the stiffening girders.

Construction Costs

Construction costs can be held down by using movable forms which can be re-used many times. The saving is appreciable, since the cost of forms is about a third of the total cost of the roof framing.

Construction time also was saved on the H. W. Moore project by removing movable forms as soon as possible. Deflection tests were made on small, 5-ft long, 3-in. square beams, with a ⅜-in. rod on the bottom. When the deflection was 0.048 inches for a single concentrated load of 140 pounds at the center, the modulus of elasticity was about 2,000,000 psi, which indicated that the forms could be moved. In cold weather, about ten days may be required, but in warm weather the time can be reduced to three days. If the shells are not supported on one side, a single row of fixed shores may be used in the center and removed when the adjacent shell is placed.

The only new construction problem involved in this type of building is the pouring of concrete on the steep slopes. If the consistency of the concrete is not just right, it will either slide downhill or it will be difficult to place and will be honeycombed. The tendency is to make the concrete too stiff. If possible, a wet batch should be placed first, followed by a dry batch. Vibration should be used sparingly.

A light grout, poured over the form just before placing the concrete, will help the concrete slide into place. The technique has been successfully used for sometime by a Mexican architect, Felix Candela, whose firm, Cubiertas Ala (Winged Roofs), has built over sixty shell roof structures in the last three years.

Curved Shell Construction

Another type of thin-concrete roof construction, widely used in this country during World War II, is the curved shell design. The flat surfaces of the folded plate design, however, offer a number of advantages over curved shell construction. Since all surfaces are straight, the construction of forms is less difficult and reinforcing bars are generally straight. Calculation of stresses is less difficult, even for unusual shapes such as the Z-shell used for the H. W. Moore building, since common beam formulas can be used. Also, the folded plate is easier to make architecturally attractive than curved shells.

The most intriguing possibility for the folded plate design is a combination with tilt-up wall construction in order to make a complete shell having the walls continuous with the roof. The tilt-up wall

—Continued on page 72

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AT THE DINNER MEETINGS, HELD MONTHLY, A PROMINENT SPEAKER DISCUSSES TOPICS OF INTEREST TO MACE MEMBERS.

Through its activities, planned to encourage high professional standards in the engineering work of its members, the Minnesota Association of Consulting Engineers has enhanced the professional status of consulting engineers in Minnesota. The Association's achievements may serve as an incentive to consultants planning similar groups in other areas.

MACE Provides Effective Organization

CE exclusive

For Minnesota Consultants

NOW SIX YEARS OLD, the Minnesota Association of Consulting Engineers has made significant progress in its efforts to advance the professional status of its members, and to provide its members' clients and the public at large with engineering service performed in accordance with the highest professional standards.

Fidelity to the client's interest—and engineering work not biased by gain from the sale of equipment or services other than engineering, is held by the members to be of utmost importance. For this reason, membership in the Association has been confined to consulting engineers in private practice and to employees of independent consulting engineering and engineering-architectural firms. A candidate must be registered as a professional engineer in the State of Minnesota, and must have "complete absence of bias through representation or financial gain by the sale of merchandise, equipment, or the contracting thereof.

Encouraging Employees

Encouraging Association membership for employees of engineering firms is one of the means by which the group works towards higher professional standards. Many of the better employees of today will be consulting engineers tomorrow, and MACE feels that anything which can be done now to promote higher professional standards among these men will benefit the entire profession. Participation in the Association gives these employees a feeling of professionality, and acquaints them with many of the problems which they will face upon entering private practice.

Since questions of office operation, fee schedules, ethics, inter-firm coordination and hiring, and education of personnel are not of immediate interest to all employees, the responsibility for studying and making recommendations on these matters is relegated to a standing committee made up entirely of employers. Recommendations for action must be made to the Executive Board, however, which does include employee members.

Growth

Evidence of the success of MACE is indicated by its rapid membership growth. Since the fall of 1948, when preparation of the Constitution first began, membership has grown from three members to 96, representing 90 percent of the consulting engineering firms in Minnesota. These members maintain offices in practically all of the State's principal cities, and one member even practices in the neighboring state of North Dakota.

Represented among the members of the Association are most of the principal branches of engineering, including electrical, mechanical, chemical, civil, structural, and mining. The size and character of the businesses represented vary from small firms working exclusively for architects to larger firms doing work for industrial clients or governmental agencies. All of these members are able to meet on

common ground because all are faced with the many problems arising as a result of their being engaged in private practice.

Meetings are held monthly, except during the three summer months. A guest speaker is usually invited to discuss a topic of interest to the members. At one meeting, an architect talked on cooperation between architects and engineers, and at another, the Dean of the Institute of Technology, University of Minnesota, described his theories on engineering education. At one of the more recent meetings, an engineer who had just returned from Brazil told of engineering conditions in South America.

One of the major factors influencing the formation of MACE was the type of competition with which consulting engineers in Minnesota had to contend. Utilities were giving free electrical plans, contractors were doing free engineering, and jobbers, wholesalers, and manufacturers were providing free planning services. Many of the Association's activities therefore have been designed to create a better understanding and improved relationships with these groups.

Activities

Meetings have been held with various contractors' associations in which all phases of their joint activity have been discussed. The contractors listed a number of ways in which the consultant's work had been inadequate and explained that if they could be assured of receiving better plans and specifications, thus eliminating the need for re-engineering, they would be able to eliminate their design departments. By so doing, they could prepare bids more quickly, install the work without delays and confusion, and decrease their overhead, thus providing the client with a better job at lower cost.

Two contracting firms have since eliminated their design departments and, as the consultants' plans and specifications improve, others are decreasing their engineering services.

Discussions with power companies brought out many of the same points listed by the contractors, particularly with respect to inadequate lighting plans. The engineers, on the other hand, pointed out that the average lighting plan prepared by a power company is not correlated with building conditions and does not show required wiring.

As a result of these meetings and the success of the engineers in improving the quality of their work, the power companies have agreed that on the larger projects, which can best be handled in the consulting engineer's office, they would advise their customers to use the consultant's services. They also have agreed to refer to their plans as "Suggested Lighting Fixture Arrangements," instead of "Lighting Plans."

A permanent Joint Committee has been formed between MACE and the Minnesota Section of the American Institute of Architects to study problems of mutual interest. Among the topics being studied are rules of practice and ethics, procedures on architect-engineer projects, standardization and improvement of all contract documents of mutual interest, and improvements in legislation designed to promote the welfare of the construction industry, the professions, and the public.

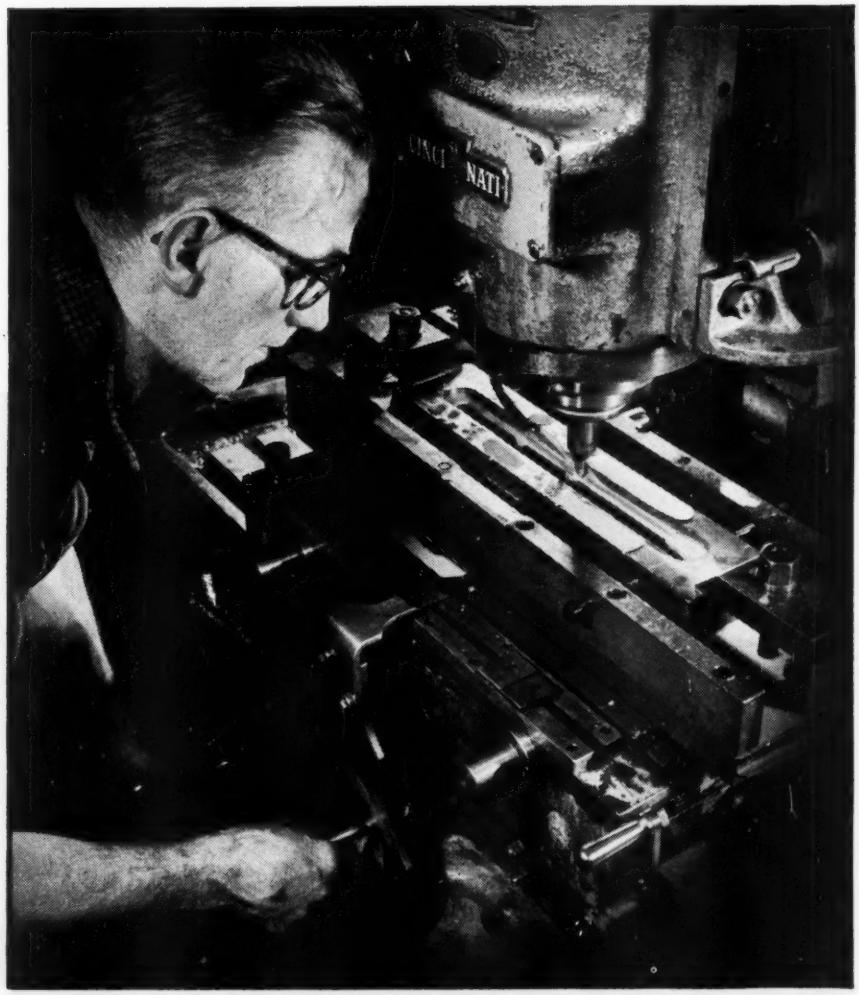
Meetings also have been held by joint committee with the AIA and the Associated General Contractors of Minnesota. One of the achievements resulting from these meetings has been the publishing of a standardized index of specification titles to be used for all building construction projects.

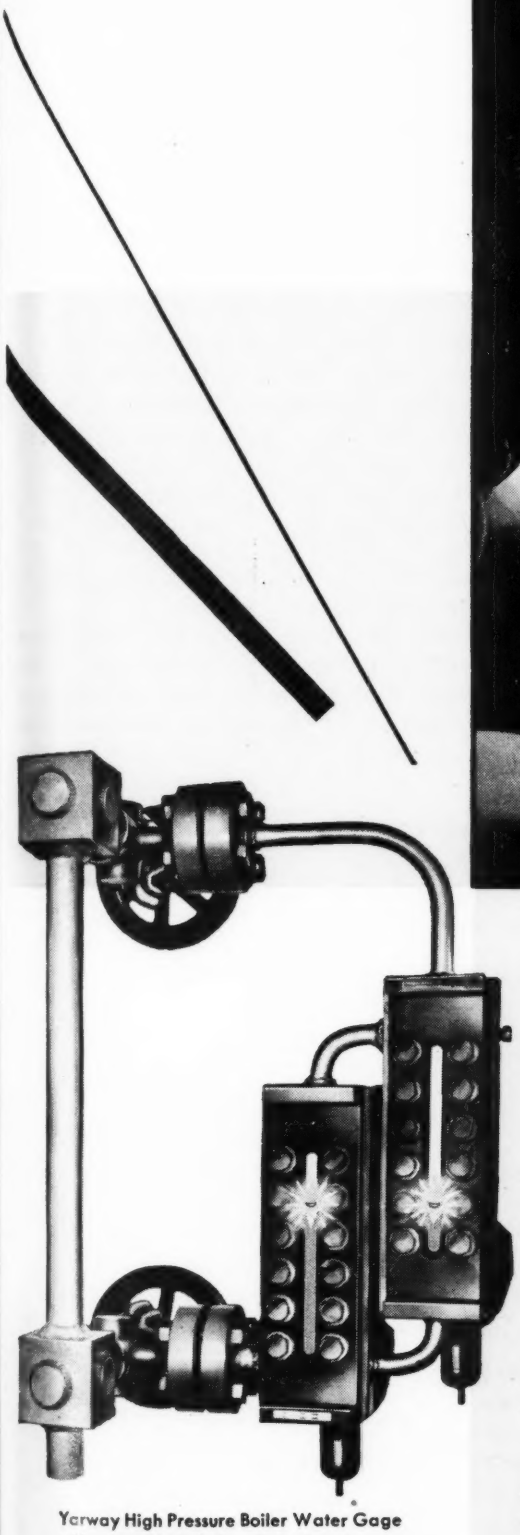
Meetings with Other Engineering Groups

Representatives of the Association have met with many of the other engineering societies, and with state and municipal departments and agencies. At these meetings, the aims and purposes of the Association are discussed, and comments are asked from the host group. These activities, plus talks given at conventions and publicity in magazines and newspapers, might be termed the public education program. As a direct result of this program, many groups are now referring questions on engineering to the Association. In a recent example, the State Electrical Inspector requested that MACE representatives assist the Electrical Code Committee in interpreting and preparing revisions to the Code.

With each new activity, the Minnesota Association of Consulting Engineers has gained momentum in its efforts to raise the professional standards of its members. The success of its program has been due to the willingness of the members to discuss their problems with each other in order to improve the quality of their work, and due to their unselfish participation in activities designed to benefit the entire consulting engineering profession. ▲▲

MACE 1953-54 OFFICERS SHOWN AT THE ANNUAL MEETING. LEFT TO RIGHT, H. G. SIERK, W. H. WHEELER, J. D. SALO, T. E. ROCHE, AND H. M. BIRD. BIRD SUCCEEDS WHEELER AS PRESIDENT.





Yarway High Pressure Boiler Water Gage with separated-design flat glass inserts. Write for Yarway Bulletin WG-1812.

HE'S A SPECIALIST ON STAINLESS STEEL INLAYS

● A dentist? No.

He's a Yarway craftsman. In the picture above he is milling a gasket groove in the stainless steel facing that is used for this important part of a high pressure boiler water gage body.

The man is important; so is the inlay.

The man is typical of the skilled workmanship that goes into every Yarway gage, blow-off valve, steam trap or other product —workmanship that makes no compromise with quality.

The stainless steel facing is typical of advanced Yarway engineering design. That inlay is but one of twelve basic improvements made in Yarway high pressure water gages.

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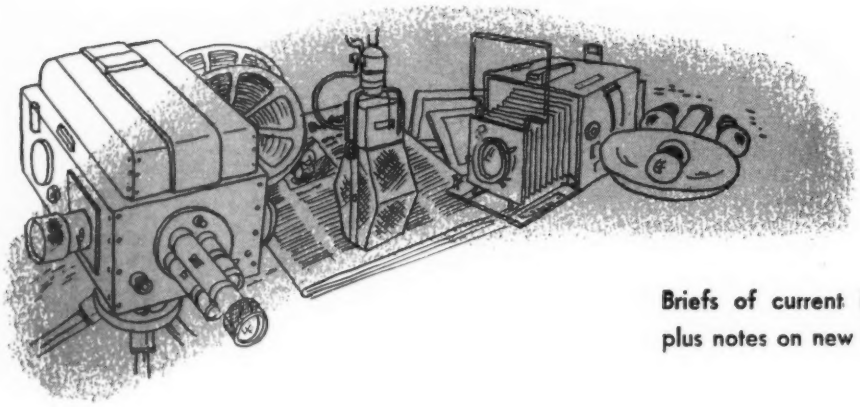


NEWS

Briefs of current interest to the consulting profession plus notes on new equipment in the field of engineering

ASME Plans for 75th Anniversary

Plans have been completed for a series of major events to be conducted in 1955 in connection with the observance of the 75th anniversary year of The American Society of Mechanical Engineers.

Of the five major national meetings during the course of the year, two will commemorate dates important in the planning and founding of ASME. Three will be held at times normally assigned to national meetings of the group.

Theme matter for the year's celebrations will center around discussion of the engineer's place in our world. According to Dr. Jess H. Davis, president, Stevens Institute of Technology, who is chairman of ASME's 75th Anniversary Committee, the areas of inquiry will concern "the engineer and his relationship with the world in which he lives and works: not just the mechanical engineer—and not just his contributions to his fellow man—but all engineers, and the entire pattern of relationships between engineers and the rest of the world."

Members of the Committee, in addition to Dr. Davis, are: T. A. Marshall, Jr., director of public relations, ASME; R. B. Smith, M. W. Kellogg Co.; A. C. Pasini, Detroit Edison Co.; Otto de Lorenzi, Combustion Engineering Inc.; and Eugene W. Jacobson, Gulf Research & Development Co.

Dates for the meetings will appear on CONSULTING ENGINEER's Calendar.

Modern Air Pollution Control "Designed-in" at Pump Works

Being a good industrial neighbor today means taking elaborate precautions to control smoke, soot and cinder discharge, to prevent stream pollution, and to avoid overloading water and sewage facilities whenever possible.

The new Fairbanks, Morse & Co., Kansas City pump and engine works has "designed-in" facilities to handle these problems. Probably the most ingeneous device is one using spark suppressors atop the cupolas. As the sparks (which become cinders) fly up, a curtain of water washes them down outside the cupola into piping which becomes an underground trough leading to settling tanks. Water from the tanks is drawn off for re-use and any water lost must run through a filter before going into the community disposal system.

These and other provisions for water re-use have reduced considerably amount of water consumed.

For smoke and fume removal there are 40 fans in the foundry alone plus 14 more for dust removal.

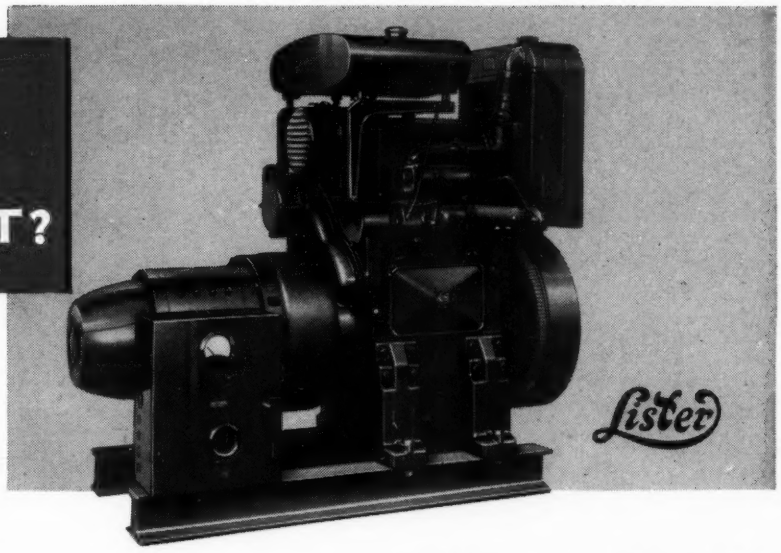
Bolts, Nuts, and Washers Used in Skyscraper Construction

One of the newer developments in skyscraper construction which may compete with rivet or welded construction is the "high strength bolt" method of erecting structural steel framework.

Bolted joints are said to be stronger than conventional joints because of the powerful clamping force exerted. To provide washers capable of transmitting this force without gorging or scoring, engineers of U. S. Steel Supply Div. of U. S. Steel, and Lindberg Steel Treating Co. have developed special heat treating methods for the washers. The heat treating also provides greater ductility which permits the washers to form with the fastened structural steel members.

Workmen of the Kilroy Structural Steel Co., Cleveland, shown erecting the framework of the

NEED A FUEL-SAVING ELECTRIC PLANT?

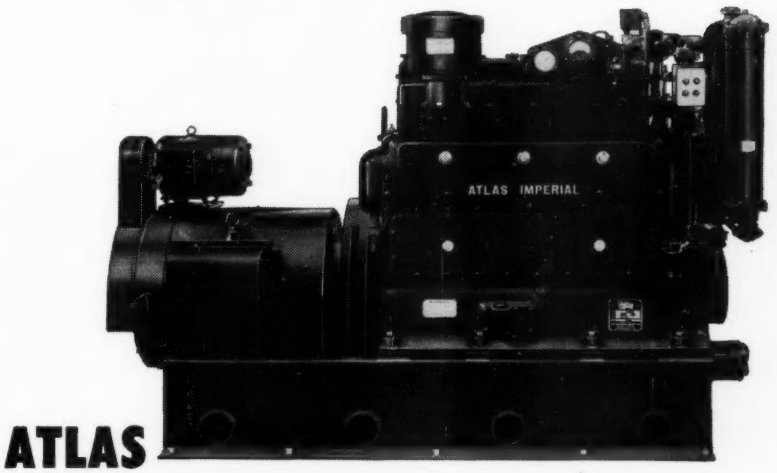


Then you'll certainly want all of the facts on the diesel engines that have consistently provided dependable power for generator operation *at the lowest fuel cost per kilowatt hour!*

These famous Superior, Atlas and Lister Diesels are widely used for generator power in municipal light plants, water works, sewage plants . . . for standby power in countless industrial operations . . . and for both propulsion and auxiliary power throughout the marine field.

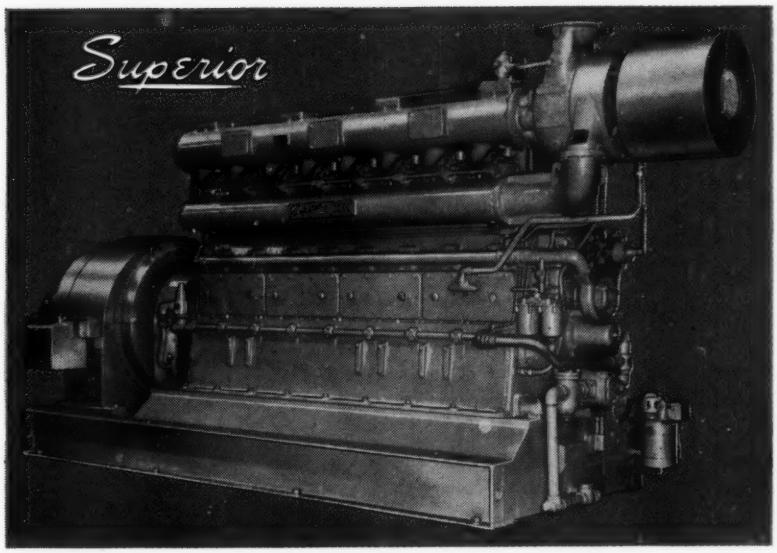
Performance and operating records from hundreds of these installations prove the exceptional economy of National Supply Diesel engines in service. This reputation, plus efficient 4-cycle design and rugged construction, make Superior Atlas or Lister Diesels your best engine investment for power generation.

These National Supply engines are available in a complete range of horsepower ratings to suit virtually every output need (check chart below). For complete information, write or call the nearest sales or service point.



ATLAS

Engine Model	Recommended Generator Capacities
LISTER FR 1	3— 5 KW
LISTER FR 2	10—12 KW
LISTER FR 3	15—18 KW
LISTER FR 4	20—24 KW
LISTER FR 6	30—35 KW
ATLAS Model 35	100 KW to 200 KW
ATLAS Model 45	100 KW to 400 KW
SUPERIOR Model 40	155 KW to 500 KW
SUPERIOR Model 60	280 KW to 645 KW
SUPERIOR Model 65	420 KW to 1250 KW
SUPERIOR Model 80	450 KW to 1000 KW



X-4019

DIESEL DUAL FUEL GAS
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ATLAS Imperial DIESEL ENGINES
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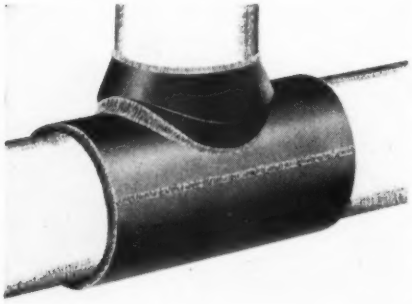
Bolt, Nut, and Washer Construction

—Starts on page 58

Cleveland-Hopkins Airport administration building, have found the bolts, nuts, and washers easier and safer to install.

General contractor for the Cleveland building is R. F. Urspring and the architect is Outcault, Guenther & Associates.

Split Tee Designed for Hot Taps and New Construction



An efficient and economical way to handle full encirclement reinforcement of branch connections is realized with use of the new Weldolet Split Tee.

Introduced by Bonney Forge & Tool Works of Allentown, Pa., the unit is specially designed for hot taps and new construction in the oil and gas transmission industries.

Assembled and ready for field installation, it meets service and size requirements from the smallest sizes to 30 in. outlets for run lines through 36 in.

NSPE Airs Views on Mandatory Social Security Coverage

On July 6th Paul H. Robbins, executive director of the National Society of Professional Engineers, appeared before the Senate Finance Committee to present the views of the NSPE on the pending legislation to extend and improve the Social Security Act.

In part, his testimony was as follows: "It will not be surprising to the Committee to learn that there is a difference of opinion within the self-employed professional engineer group regarding mandatory coverage proposals. We have emphasized the word "mandatory" because there is no substantial difference of opinion with respect to voluntary coverage. Almost all of those who have expressed themselves find no objection whatsoever to the voluntary approach as this would obviously satisfy both sides — those who want inclusion could obtain it, those who oppose inclusion for any reason, could eliminate themselves.

"Our studies and polls indicate that on the question of mandatory coverage, approximately 55 percent are opposed and about 45 percent would accept it. Those who are opposed cite a variety of reasons for their position, including the economic soundness of the program compared to private insurance, and personal political philosophy. The major objection, by far, however, is the one we have alluded to previously. That is the fact that because of the earning limitation in the law most self-employed professional engineers feel they will pay into the fund for a number of years and upon reaching the age of 65 they will not be eligible for the monthly benefits because their continued earnings after that age will be more than the permitted amount. The proposed increase in the limitation to $1000 per year does not alter the basic consideration of this point. We do not suggest that this phase of the problem could be resolved by raising the earning limitation to a higher figure than that proposed, because it is quite unlikely that the figure could or should be raised to a sufficiently high point to permit the receipt of monthly benefits under most or all cases. Such a step would be tantamount to repeal of the earning limitation clause, which has been suggested in some legislation. It is realized that the removal of the earning limitation clause would place a heavier demand on the fund and would require the imposition of a higher contribution rate to maintain a sound actuarial basis.

"A particularly unfair aspect of imposing mandatory coverage on self-employed professional engineers would occur in the case of those who had been employees in the past and thus covered by social security, and upon reaching eligible retirement age had gone into private consulting work. This is not an unusual situation in engineering, bearing in mind that the vast majority of professional engineers in this country are salaried people.

"In the light of all the above considerations, we feel that the only sound approach is to provide a voluntary coverage system for self-employed professional engineers. This is not a new proposal and we realize that it requires the solution of some administrative problems. However, these problems are not as severe as would be the injustices and problems arising from compulsory coverage when the majority of those directly concerned are strongly opposed to such mandatory treatment.

"The traditional argument advanced against our recommendation is that the voluntary approach will result in "adverse selection" and thus there will be an undue drain on the fund.

"This may be a sound theory on an overall basis but it does not reflect the general facts of self-employment in the engineering profession. We have pointed out that the pattern in engineering is that the great majority are employees and it is almost without exception that the engineering graduate is an employee for a considerable number of years before he has acquired the experience and reasonable expectation of being able to succeed as a self-employed consulting engineer.

"There is no reason to believe that the pattern will change in the future regarding entry into self-employment consulting services at middle age or later after a period of prior employee service. If voluntary coverage were made available to this group we believe that those who would choose inclusion would be the group with substantial past coverage as employees in order to protect and enhance their past contributions, and those in the younger age brackets

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*CB — Carbon Black (U. S. Patents 2,102,129, 2,405,853) Reg. U. S. Pat. Off.

**F-3 — Arsenic-Lead Alloy (U. S. Patents 2,300,788, 2,375,755, 2,504,600 and 2,570,501) Reg. U. S. Pat. Off.

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NSPE on Social Security

—*Starts on page 60*

who would be primarily concerned with the family protection benefits. Those in the older age brackets would more likely decline coverage so they could continue their practice after the age of 65, taking such benefits as they may be entitled to by reason of their earlier employee status. In other words, our study and the comments of those involved indicate to us that the "adverse selection" theory would work in reverse as applied to self-employed professional engineers.

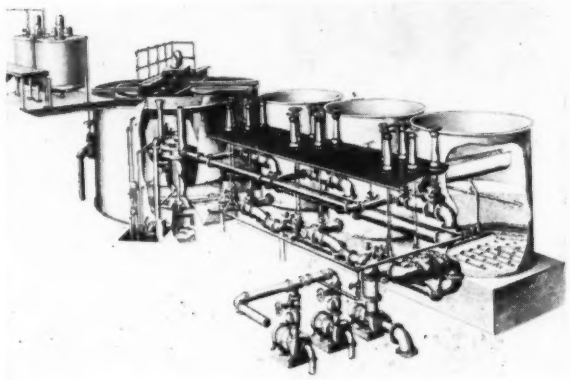
"We are at a loss to understand the discriminatory treatment decided upon by the House Committee as regards self-employed professionals. The explanation offered by those in charge of the legislation was two-fold: (1) doctors do not retire at the age of 65, but continue their practice normally well past that age, (2) that there was a substantial difference of opinion among the affected professional groups except for the doctors who almost unanimously opposed mandatory inclusion.

"If these two reasons are valid for the separate treatment of doctors they are even more valid in the case of self-employed professional engineers. Like the doctors, the pattern among self-employed professional engineers is to continue their practice without regard to the arbitrary age of 65. In fact, the incentive and inducement to do so is stronger now than ever before in view of the unusually high demand for engineering services of all types which has been the subject of so much comment by the highest officials in government, industry, and other fields. If the action of the House stands, it will induce some self-employed professional engineers to abandon their practice when they are most needed.

"The second point is even more baffling. To the best of our knowledge representatives of the several engineering societies in this country, representing in the aggregate almost all self-employed professional engineers, have unanimously opposed mandatory inclusion of the self-employed professional engineers. No organization in the engineering profession has taken a contrary stand. This is not true in the case of the organizations representing the medical profession where there was a difference of opinion, both on a national organizational basis and with respect to state organizations. We know of no state engineering organization or other engineering organization which has advocated coverage of self-employed professional engineers on a mandatory basis.

"Throughout this testimony we have been referring to a relatively small segment of the engineering profession. Of the approximately 180,000 registered professional engineers in the United States (the only group eligible to offer their services to the public as consulting engineers) only about 15 percent are in private practice.

"However, it is an important and vital segment of a key profession and a group which should have the encouragement to stay in active work rather than a change in the law which will induce many to leave the field. The Social Security system is intended to serve the welfare of those affected by it. Therefore, it would appear that the interest of identifiable groups can best be served by providing a system which reflects the desires of that group without imposing undue burdens on others. We have tried to demonstrate that in the case of self-employed professional engineers that desire, based on sound reasons, is for a voluntary coverage system. If the Committee feels that it cannot recommend such a system then it would be the position of our organization that the law should be left as it is insofar as the self-employed professional engineers are concerned; that is, they should be excluded completely."



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For economy-minded smaller communities, Graver Water Conditioning Co. is offering a compact and completely integrated package-type water treatment plant.

Included in the "package" is all equipment from inlet to outlet, including the clearwell, chlorinator, wet or dry chemical feeders and proportioners, gravity or pressure filters, recarbonator when required, level and flow controls and instruments, and interconnecting piping. Standard layouts for the complete plant are available in a wide selection of capacities from 0.1 to 2.0 mgd, special layouts being available for larger capacities.

The heart of this low-cost plant is the Graver Reactivator, a cold-process water treating unit used for selective or simultaneous removal of turbidity, color, and organic matter; taste and odor; iron and manganese; and hardness from water supplies. Detention time is only 60 to 90 min. instead of the normal 3 to 6 hr.

Gravity filters for many plant capacities are completely shop assembled to achieve maximum economy in field installation. Instrumentation and controls are functionally arranged to provide simple yet fool-proof manual or automatic operation.

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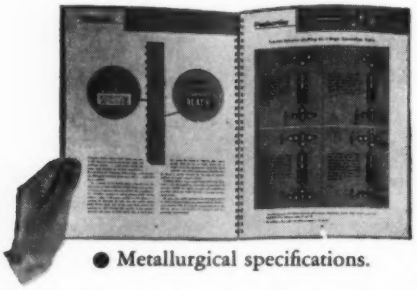

● Metallurgical specifications.

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MEN IN ENGINEERING

★ John M. Barnhart formerly with Western Electric Co. of N. Y. is appointed executive director of the Industrial Mineral Fiber Institute, Inc. His headquarters are in the Institute offices at 441 Lexington Avenue, New York, N. Y.

★ Rehabilitation of facilities for the manufacture of high explosives at the Kankakee Unit of Army Ordnance's Joliet Arsenal in Illinois is now complete, according to The Rust Engineering Co., the engineering-constructor.

★ Professor Charles O. Gunther is appointed research consultant for the L. B. Foster Co.

★ The Atomic Energy Commission announces that Stone & Webster Engineering Corp. will perform architect-engineering services associated with the design of the Pressurized Water Reactor (PWR) Project to be constructed at a site near Shippingport, Pa. Stone & Webster will be a subcontractor under Westinghouse Electric Corp., prime contractor on the project.

★ Merritt-Chapman & Scott Corp. announces election of Ambrose J. Hartnett as a vice president responsible for planning and development of new construction projects.

★ F. H. McGraw & Company and Power Corporation of Canada, Ltd. announce incorporation of a new Canadian engineering and construction firm to be known as F. H. McGraw Co. of Canada, Ltd., with headquarters in Montreal.

★ F. W. Argue has been named engineering manager of Stone & Webster Engineering Corp. with headquarters in Boston. Senior consulting engineer in charge of engineering reports and appraisal activities is W. F. Ryan, vice president.

★ H. Emerson Thomas, president of H. Emerson Thomas and Associates, Inc., Pennsylvania and Southern Gas Co., Suburban Fuel Tank Car Co. and affiliated companies, has received the Distinguished Service Award from the Liquefied Petroleum Gas Association for his outstanding contributions to progress of the Association and industry.

★ American Standards Association Inc. appoints George Porter Paine assistant secretary and John W. McNair assistant technical director. Paine will also continue as director of public relations and McNair will continue as secretary of the U. S. National Committee of the International Electrotechnical Commission. S. David Hoffman is named

DIESEL APPLICATIONS

American Locomotive Co. played host to more than 40 key oil and pipe line executives interested in stationary diesel engine applications at the Schenectady plant. Shown in the Diesel Engine Laboratory are, L. to R.: A. T. Lawrance, Alco; J. R. Polston, Service Pipe Line Co., Tulsa; John Thomas, Alco; and L. F. Scherer, Texas Pipe Line Co., Houston.

engineer in charge of electrical projects, and F. Crampton Frost will succeed the late H. M. Lawrence as manager of standardization projects in material, construction, and mining.

★ Assistant to the executive vice president of H. K. Porter Co., Inc. is W. Harvey Thompson. He succeeds R. F. Allen who is elected a vice president in charge of the Buffalo Steel Div.

★ Truman Young is appointed manager for Market Development of Walter Kidde & Co., Inc.

★ Brown, Blauvelt & Leonard, chemical and industrial engineers, appoint Brook J. March technical sales representative.

★ Barnes & Reinecke, Inc., sold a year ago to Joy Mfg. Co., has been purchased by a group of B&R employees. Thomas W. Alder will continue as president.

★ Following his resignation from the U. S. Atomic Energy Commission James K. Pickard has opened a consulting practice in atomic energy development. His offices are at 1518 K Street N. W., Washington 5, D. C.

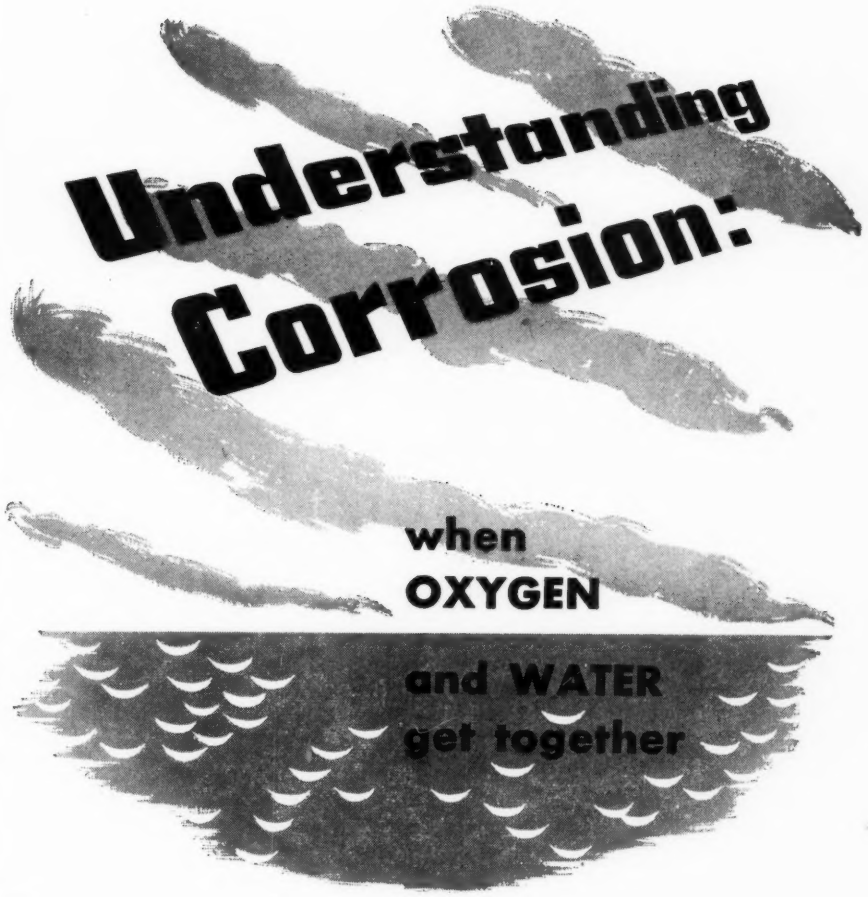
★ Ebasco Services Inc. announces opening of a Dallas office in the Southland Life Building, to be headed by W. A. Buchanan.

★ Michael Baker Jr., head of the firm of Michael Baker Jr., Inc. is appointed to the Pennsylvania State Board for the Registration of Professional Engineers. His firm also announces receipt of a $132,200 contract from the Mobile District Engineer, U. S. Army Corps of Engineers, at Mobile, Ala.

★ Wilbur A. Carter, technical engineer of power plants for Detroit Edison is retiring from his regular duties after more than 40 years with the company. He is being retained as a consultant on the company's River Rouge generating plant project and also as a consultant to the Nuclear Power Development Dept.

★ Colonel John H. Carruth, U. S. Army retired, joins the staff of V. L. Beavers and Associates, consulting engineers of San Antonio, Texas. Colonel Carruth, who until his retirement was in the Corps of Engineers, was recently elected 2nd vice president of the Society of American Military Engineers.

★ Chief geologist for the Texas Gas Transmission Corp. gas supply department at Shreveport, La. is Monty G. Martin.



When free oxygen combines with atmospheric moisture or natural waters, the stage is well set for corrosive action. Controlling the degree and extent of that action are many related factors, variable in influence under differing circumstances.

The rate at which oxygen is transferred from atmosphere to a solution is, for example, directly proportional to the amount of exposed surface area of that solution, while the corrosion rate of immersed metal is, in turn, proportional to the oxygen concentration of the solution. Therefore, with all other factors stabilized, a reduction in exposed surface area will slow the oxygen-solution process, thereby greatly retarding corrosion.

How deeply metal is immersed, particularly in a quiet solution, is another determinant of corrosive action in which dissolved oxygen is the governing factor. Oxygen saturation, highest at and near the surface, diminishes with increasing depth as convection currents become less active. Corrosion at and immediately below the surface of a liquid is therefore far more severe than that encountered at greater depths.

These and other variables that combine to produce a given corrosion problem must be evaluated in any attempt to reach an effective and practical solution. Such evaluation, based on thirty-five years' corrosion-control experience, is standard Dampney procedure. That is why your specification of a Dampney Coating assures you so much *more* — protection you can depend upon to meet not only standard industrial service requirements but your specific equipment-operating needs. For data on Dampney Protective Coatings and their place in your corrosion-control program, write

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THE DAMPNEY COMPANY

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More Accurate Level Reading of LOW TEMPERATURE LIQUIDS . . .

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Large Chamber

NON-FROSTING* GAGES

YOU get the highest possible accuracy of reading on low temperature, low boiling point liquids with the patented Jerguson Non-Frosting Gage in the New Large Chamber model . . . because it insures less turbulence at the meniscus, and clear vision at the vision slot.

This new Jerguson model has 6 times larger area at the meniscus than the standard gage, so that there is a marked reduction in turbulence with light gaseous fluids that tend to boil or surge. Moreover, the problem of frosting encountered with these liquids has been eliminated by a patented frost preventing unit extending from the gage glass. This special transparent unit projects beyond the cover bolts and prevents frost from building up over the vision slot.

Here's a dual feature gage that assures greatly increased accuracy of reading for the process industries. If you have a problem with light gaseous fluids, or with gage frosting, it will pay you to investigate the new Jerguson Large Chamber Non-Frosting Gage . . . reflex or transparent.

Jerguson Large Chamber Gage, Transparent Type, with the patented Non-Frosting Gage Glass Extension. Write for literature on this gage, and on other non-frosting Jerguson models.

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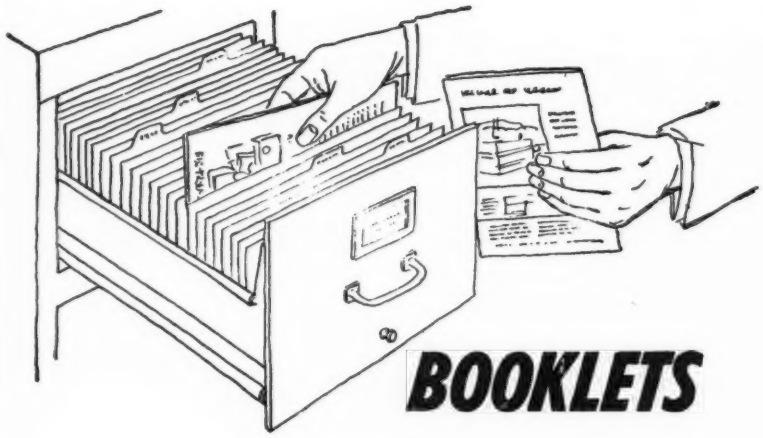


BOOKLETS

"J-M RASCHIG RINGS," 4-page folder SA-48A, provides data for engineers designing and constructing new absorption and extraction towers and for those who specify packing for existing towers. The split metal rings described can be made from any required metal in diameters from ¼ to 3 in. *Johns-Manville, Dept. CE, 222 East 40th St., New York 16, N. Y.*

STEEL SHEETS AND PLATES—Perforated patterns available for shipment from stock, and other patterns supplied perforated to order from carbon and stainless steel sheets and plates, for safety, ornamental and screening purposes, and for manufactured articles are described with typical layouts and all specification details. *Joseph T. Ryerson & Son, Inc., Dept. CE, P. O. Box 8000-A, Chicago 80, Ill.*

TYPE TF VENTURI, a small unit specifically designed for the measurement of fluids in quantities ordinarily considered too low for the application of a normal size Venturi or orifice is described in this five-page technical bulletin. Limitations of application, uses, and discharge capacities are listed. *Simplex Valve and Meter Co., Dept. CE, 68th and Upland Sts., Philadelphia 42, Pa.*

PACKAGED BOILERS—The new line of simplified Powermaster packaged automatic boilers in sizes 15 through 100 hp, light oil or gas, are discussed in eight-page bulletin 1230. Details of design and construction, a cutaway view, and sample specifications are given. *Orr & Sembower, Dept. CE, Morgantown Rd., Reading, Pa.*

VELOCITY STAGE class CA turbines described in four-page folder 4202 are of simple, rugged construction and are designed for mechanical drives. Cut-away drawing shows general arrangement of the turbines, which operate under all inlet steam conditions up to 600 psig and 750 F. Principle specifications, materials, and standard and optional features are listed. *De Laval Steam Turbine Co., Dept. CE, Trenton 2, N. J.*

A WEALTH OF NEW MATERIAL on air-conditioning cooling tower applications, specifications, selection, and installation are included in 16-page catalog WT & CT-583. Tables, drawings, and graphs describe the operating characteristics of twenty standard cooling towers ranging in capacity from 5 through 60 tons. *Halstead & Mitchell, Dept. CE, Bessemer Bldg., Pittsburgh, Pa.*

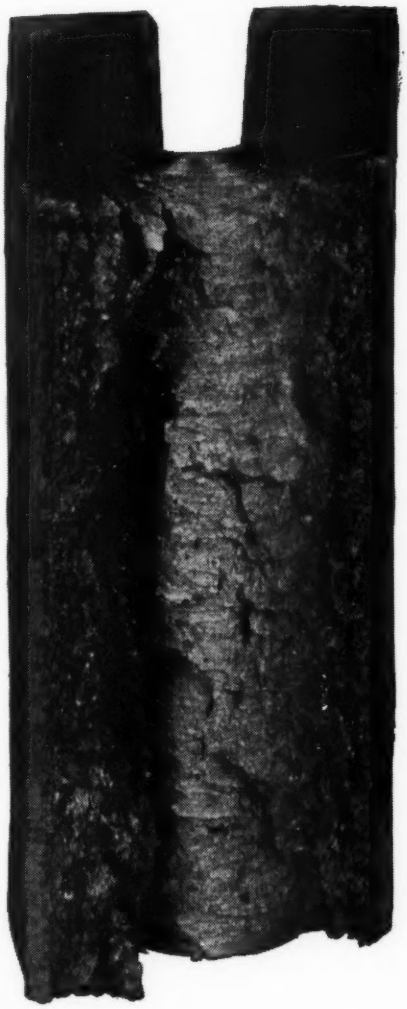
PORTABLE POWER PLANTS, 3600 rpm manually starting models in sizes of 650, 1350, and 2000 w, are described in eight-page booklet LP 354. An 1800 rpm series driven with air cooled engines in sizes from 500 through 5000 w is also shown. Rating, general features, and accessories are given for each unit. *Katolight Corp., Dept. CE, First Ave. at Chestnut, Mankato, Minn.*

TWO-LEVER COORDINATION CONTROL application engineering data in bulletin 68123 will be valuable to engineers concerned with safety, control, and operating devices for pneumatically-actuated equipment and processes. One section is devoted to analyzing uses for various manual and automatic actuation systems. *Pantex Mfg. Corp., Dept. CE, P. O. Box 66, Pawtucket, R. I.*

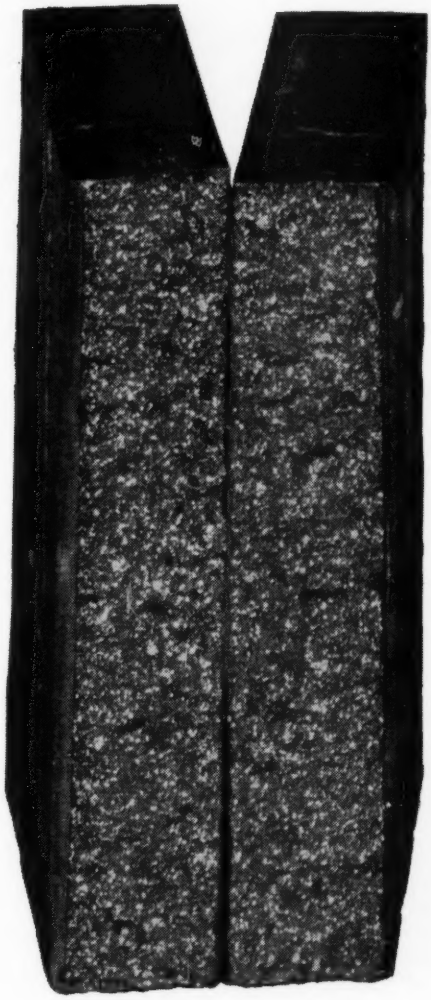
CLOSED-CIRCUIT TELEVISION EQUIPMENT — Twenty basic applications of closed circuit television "TV Eye" are described in booklet 3R2335. Use of the unit is shown in production control, remote observation, training and instruction, process control, surveillance, dangerous viewing, and

Personal copies of booklets can be obtained by writing directly to the manufacturers

HERE IS THE DIFFERENCE



WROUGHT IRON



STEEL

These are actual photographs of fractured pieces of wrought iron and steel. The picture at the left shows the fibrous structure of wrought iron. How this differs from the crystalline structure of steel is readily apparent. It is the presence of many thousands of tiny threads of glass-like iron silicate that gives wrought iron this unique fibrous structure and it is this structural feature, duplicated in no other metal, that gives wrought iron its superior resistance to corrosion and fatigue stresses.

While the initial cost may be higher, actual service records in numerous applications prove that wrought iron is the most economical buy because it lasts longer. Ask any Byers Field Service Engineer to show you fractured pieces, similar to those illustrated above. Write for our booklet, "The ABC's of Wrought Iron."

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY STEEL PRODUCTS

BOOKLETS —*Starts on page 66*

materials handling. *Engineering Products Div., Radio Corp. of America, Dept. CE, Camden, N. J.*

REPETITIVE MANUFACTURE Power Transformers being built at the new Rome, Ga. plant are described in 40-page booklet GEA-6108. It cites the application and features of standardized single phase and three phase units, ranging from 501 to 10,000 kva, and lists dimensions, ratings, and specification. *General Electric Co., Dept. CE, Schenectady 5, N. Y.*

PORCELAIN CHEMICAL EQUIPMENT is the subject of 24-page bulletin 438. Usefulness of porcelain as a material of construction is stressed. Equipment described includes Y and angle valves, safety valves, plug cocks, pipe and fittings, towers, tower plates and nozzles, and raschig rings. *Lapp Insulator Co., Inc., Dept. CE, Process Equip. Div., LeRoy, N.Y.*

REFRACTORIES, Coleman XX, for high duty service; and Coleman, for intermediate duty service, are detailed in eight-page bulletin ED-D. Charts shown spalling resistance, the results of load tests, and thermal expansion. *Harbison-Walker Refractories Co., Dept. CE, Farmers Bank Bldg., Pittsburgh 22, Pa.*

AIR/GAS PROPORTIONAL MIXERS for various operating conditions are pictured in four-page folder L. Summary information is given for each type along with the number of the bulletin giving detailed information. Tables show losses due to excess gas or excess air. *Eclipse Fuel Co., Dept. CE, Rockford, Ill.*

MOTOR STARTERS having short circuit protection for 2200 to 5000 v systems are described in booklet 1062. Valimitor starters which will safely interrupt the circuit from a bus of unlimited capacity, and starters using the EC&M 50,000 kva interrupting capacity type ZHS contactor are shown in indoor and outdoor installations. *The Electric Controller & Mfg. Co., Dept. CE, 2700 E. 79th St., Cleveland 4, Ohio.*

"NICKEL STEELS and Other Nickel Alloys in Bridge Construction," bulletin A-179, 36 pages, presents modern usage and past history of nickel alloys in bridge construction. Examples of use of other materials such as ductile iron, Monel, nickel cast iron, and cast nickel alloy steel are given. *International Nickel Co., Inc., Dept. CE, 67 Wall St. N. Y. 5.*

AUTO CENTRAL FILTER CONTROL, a system of semi-automatic sequence operation for back-washing rapid sand water filters is explained in four-page bulletin 480-L1. Flow diagrams and drawings illustrate the principles of operation. *Builders-Providence, Inc., Dept. CE, Providence 1, R. I.*

HYDRO-PNEUMATIC TANK calculator tells you instantly the best air-water ratio, the most efficient pressure differential, the exact amount withdrawn on any pressure drop, and the resultant reserve. Printed on heavy board, the calculator operates on a slide rule principle. *Automatic Control Co., Dept. CE, St. Paul 4, Minn.*

"BOILER BLOWDOWN CONTROL," technical paper No. 128 is a reprint from INDUSTRY AND POWER, March 1954. Principal types of boiler blowdown are discussed, as well as various control methods necessary to assure production of pure steam and the keeping of heat transfer surfaces free of scale and other objectionable deposits. *W. H. & L. D. Betz, Dept. CE, Gillingham & Worth Sts., Philadelphia 24, Pa.*

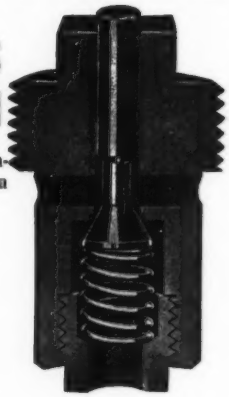
HIGH PRESSURE PRACTICE and high rates of evaporation have greatly increased the amount of boiler blowoff required according to 11-page bulletin 2391A. How automatic continuous blowoff equipment successfully meets the demands of modern boilers is explained. Typical arrangements are illustrated together with cost-saving ideas. *The Permutit Co., Dept. CE, 330 W. 42nd St., N. Y. 36, N. Y.*

"ALCOA ALUMINUM HEAT EXCHANGER TUBES," presents the complete story on aluminum heat exchanger tubes, emphasizing factors that provide a combination of low cost and corrosion resistance. This 24-page booklet was designed to be a basic reference source for engineers. *Aluminum Company of America, Dept. CE, 728 Alcoa Bldg., Pittsburgh 19, Pa.*

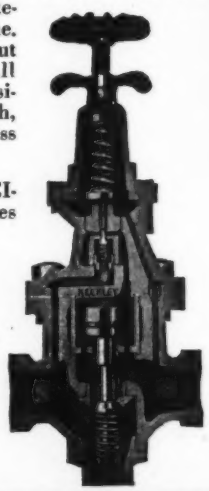
LUBRICATED PLUG VALVES in full-port and venturi types are shown in

UNIT PILOT VALVE

MAKES KECKLEY REGULATORS EASIER TO SERVICE AND MAINTAIN



Here is a unique Keckley feature that means extra convenience and savings for you. The pilot valve can be removed as a unit. This means easy inspection, maintenance or replacement in a few minutes' time. No bother with separate parts—comes out as easily as the spark plug in your car. All other parts of this valve are readily accessible too! All wearing parts are made of tough, long wearing, corrosion resistant stainless steel, further lowering upkeep.



Check into the Keckley line of PRECISION PRESSURE REGULATORS. Sizes ½" to 6"—pressure to 300 lbs. steam, 600 lbs. air, reduced to a low of 1 lb. various combinations for pressure and temperature control. Ask our representative, your industrial distributor, or write.

- Float Valves
- Pressure Regulators
- Temperature Regulators
- Float Boxes
- Pop Safety Valves
- Strainers
- Level Controllers
- Diaphragm Valves

SEND FOR COPY OF COMPLETE CATALOG 54-I

O. C. KECKLEY COMPANY
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AFTER-COOLER FOR NEW DETROIT FOUNDRY

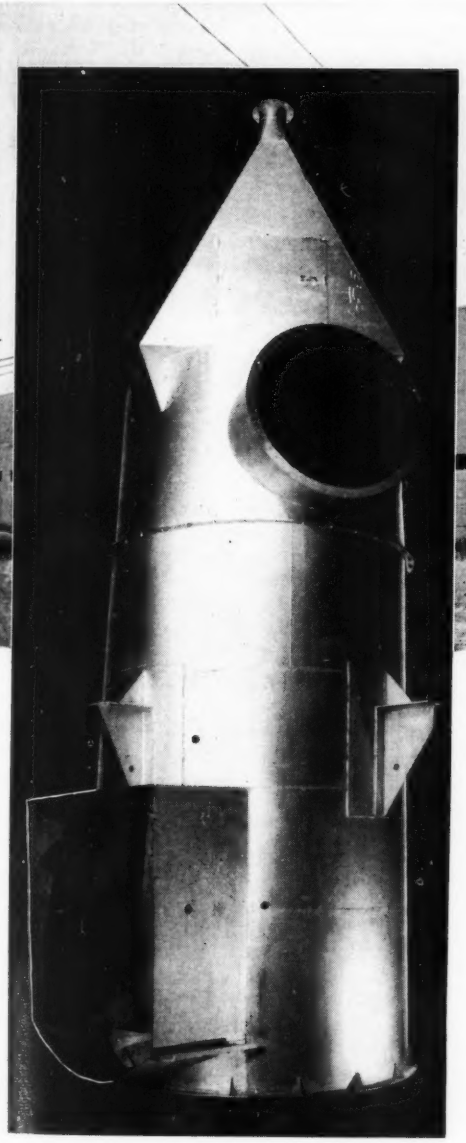


Photo at left shows one of two cooling chambers, integral components of vortex type dust collectors. Special design by Grindle Corporation eliminates dust, fumes, general smoke nuisance from expanded cupolas and stacks of major Detroit automobile manufacturer.

After-cooler pictured above is typical of heavy *precision* weldments manufactured by Foster. New building has heavy duty over head crane facilities; houses new equipment for shearing, burning, bending, braking, forming, annealing, sand-blasting.

Raw materials from nearby Gary-Chicago mills; deliveries by motor freight, railroads, barges via Illinois and St. Lawrence Waterways.

The costs are moderate, fine quality and agreed delivery are sole standard at Fosters.

THE **foster** COMPANY ST. JOSEPH, MICHIGAN

Circle 534 on Reply Card for more data

BOOKLETS —Starts on page 66

24-page reference book 39-5. Engineering information includes principal dimensions, types of control, metals, and lubricants. *Homestead Valve Manufacturing Co., Dept. CE, Coraopolis, Pa.*

MANUALLY OPERATED BALL VALVES for water works and industrial applications are discussed in eight-page booklet 159. Large front view and sectional assembly drawing, with descriptions of standard settings, sectional assembly, and principal parts lists, make this a handy reference. *F. Morgan Smith Co., Valve Div., Dept. CE, York 8, Pa.*

WOOD PRODUCTS — engineering and research facilities being applied by the lumber industry's service organization, Timber Engineering Co., are described in 12-page handbook 50M, "For Users of Wood and Forest Products." It outlines activities in engineered timber designing and testing at TECO laboratory. *Timber Engineering Co., Dept. CE, 1319 18th St., N. W., Washington 6, D. C.*

OPERATION and construction of single-stage water-cooled rotary compressors and vacuum pumps applicable to every air or gas handling requirement are described in 12-page bulletin 16B8126. It lists general specifications along with typical air piping arrangement diagrams and proper accessories designed to give the most satisfactory results. *Allis-Chalmers Mfg. Co., Dept. CE, 943 S. 70th St., Milwaukee, Wis.*

ENGINEERING bulletin J-73 provides specifications and descriptions on the complete line of 13 in. bore and 16 in. stroke diesel, gas-diesel and spark-ignited gas engines. Performance charts of the atmospheric and super-charged engines are included. *Cooper-Bessemer Corp., Dept. CE, Mount Vernon, Ohio.*

SIXTY-PAGE HYDRAULIC handbook, bulletin 50, is a compilation of the latest available tables and engineering information pertaining to heavy duty pumps. Included is a condensed catalog of this company's pumps and related equipment. *Aldrich Pump Co., Dept. CE, Allentown, Pa.*

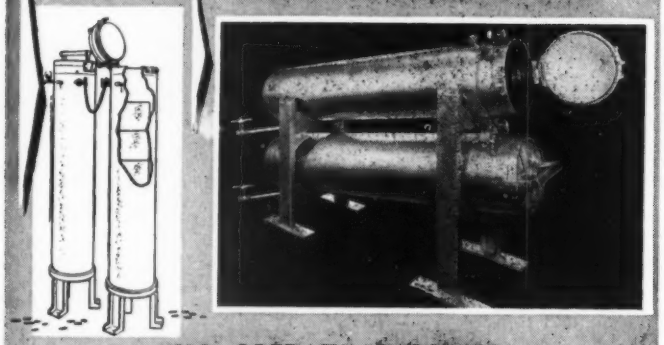
EN MASSE CONVEYOR — This bulletin explains how an enclosed endless chain, fitted with specially designed flights, conveys such free flowing materials as grain, resins, and fine chemicals in vertical, horizontal, or inclined planes. It includes dimensioned engineering drawings and an isometric cut-away section of a vertical run of the Flowmaster conveyor. *Gifford-Wood Co., Dept. CE, Hudson, N. Y.*

"SOURCES OF WATER," six-page folder discusses basic water-procurement problems, and cites examples from industrial experience in meeting plant water requirements. *Hall Laboratories, Inc., Dept. CE, Hagan Bldg., Pittsburgh 30, Pa.*

CHARTING METHOD — Prefabricated charting of statistical charts, organization charts, and office layouts are described in 16-page booklet "Visualization Made Easier." A full description of the method and the

for PURGING . . .

DRY ICE CONVERTERS



NO OPERATING COSTS!

Dry Ice Converters are A.S.M.E. code pressure vessels especially adapted for charging full-sized 50-lb. cakes of solid CO_2. They may be located any place in a plant and connected by pressure piping to the gas use area. A variety of sizes are available for either vertical or horizontal installation. No electricity, fuel or refrigeration needed.

Write for folder and prices

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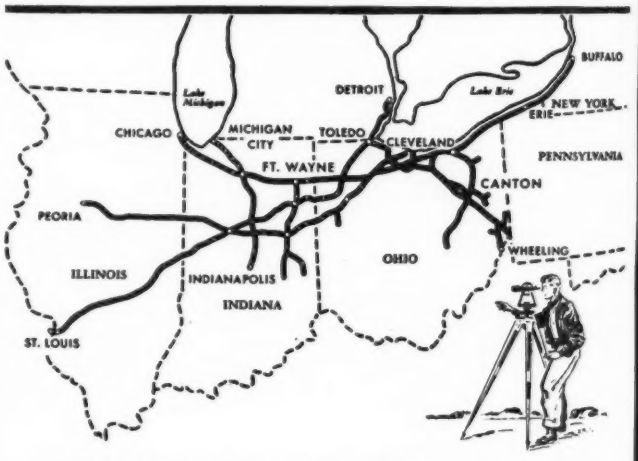
DRY ICE CONVERTER CORPORATION

Dept. C., Box 1652, Tulsa, Okla.



LOOKING FOR INDUSTRIAL SITES?

Let "Nick Plate" send you our detailed and accurate "Along the Line" surveys covering natural and agricultural resources, utilities, labor and other pertinent data relating to each specific location. Just tell us the area or type of location you are interested in. Call or write:

INDUSTRIAL DEVELOPMENT DEPT.

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NICKEL PLATE ROAD

kits necessary is included. *Chart-Pak, Inc., Dept. CE, Stamford, Conn.*

HEAVY DUTY FANS (Series 2000) for induced draft service are described in detail in eight-page catalog 1380. It gives maximum wheel speeds, total pressures, and volume ranges for three size classes. Power savings possible with use of optional inlet damper control are discussed. *Westinghouse Sturtevant Div., Dept. CE 072, 200 Readville St., Hyde Park, Boston 36, Mass.*

ILLUSTRATED case histories on this company's autopositive paper, bulletin 8-51, 11 pages, provides specific instances of use in the drafting room, reproduction department, and for making intermediates from engineering drawings. Other types of photographic paper are also described briefly. *Eastman Kodak Co., Dept. CE, Industrial Photographic Div., Rochester 4, N. Y.*

FORTY YEARS in the steam and electrical control field is commemorated by redesigned catalog 54. With the description of products are included quick tables on pressure and temperatures, and water heads. *O. C. Keckley Co., Dept. CE, 400 W. Madison St., Chicago 6, Ill.*

THE "K" PUMP, result of long experience in the solution of proportioning problems, is shown in detail by means of a two-page foldout in five-page bulletin KP-54. Capacity and pressure tables will help you choose pumps for specific needs. *Hills-McCanna Co., Dept. CE, 3025 N. Western Ave., Chicago 18.*

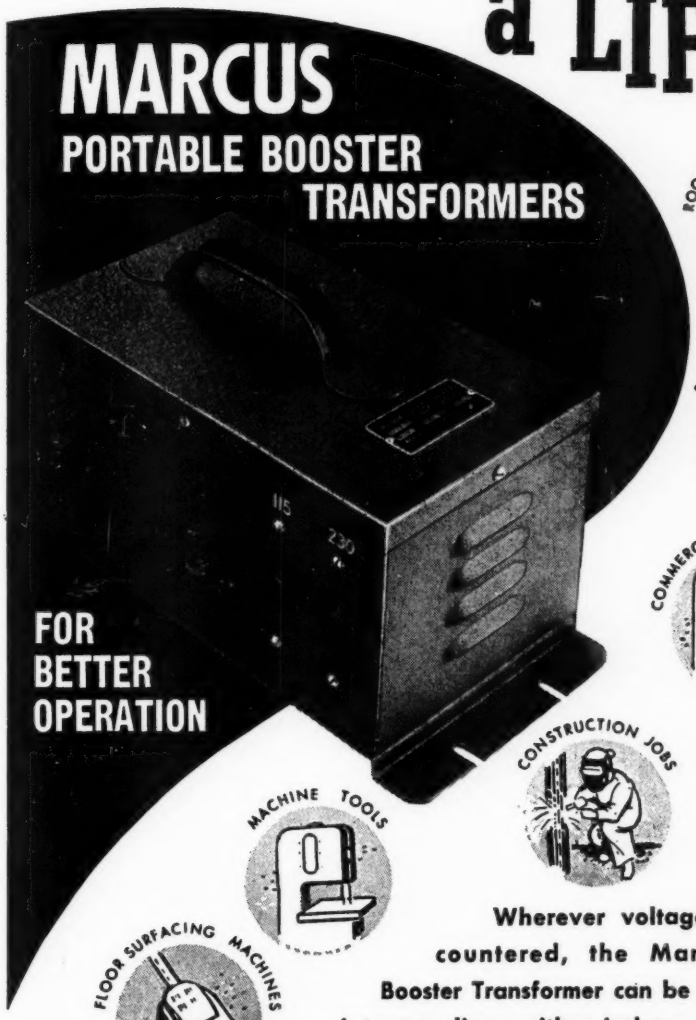
DATA UNIT 237 covers special purpose heated and cooled gages and valves which are said to solve the problem of getting accurate level readings of liquids that boil or surge —or liquids that are heavy and don't flow at normal temperature. *Jerguson Gage & Valve Co., Dept. CE, 80 Fellsway, Somerville 45, Mass.*

"GRAPHITIZATION," a report on a ten-year study, discusses the problem from a standpoint of temperature, chemical composition, deoxidation practice, and stress and strain. Photographs and drawings illustrate structural formations of steel. *Edward Valves, Inc., Subsidiary of Rockwell Mfg. Co., Dept. CE, 1201 W. 145th St., E. Chicago, Ill.*

FLANGE GASKET AND BOILER GASKET easy-reference dimension tables and bolting data are included in catalog AG-953. Shown are types for raised face, crane-lap, and Van Stone joints, flange unions, male and female joints, and tongue and groove fittings, for all standard makes of boilers and accessories. U. S. *Gasket Co., Dept. CE, Camden 7, N. J.* ▲▲

GIVES SAGGING VOLTAGES a LIFT...

MARCUS
PORTABLE BOOSTER TRANSFORMERS



FOR BETTER OPERATION

Wherever voltage drop is encountered, the Marcus Portable Booster Transformer can be easily plugged into any line—either indoors or outdoors—to quickly restore necessary voltage level. Ideal for any application where appliances or machines are not operating at top efficiency due to low line voltage. Equipped with voltage input receptacles for 95 - 105 - 115 - 208—to deliver 115 and/or 230 volts in any combination.

IN	OUT
95 105 115 208	115 and/or 230

With a capacity of 3000 watts or 3 KVA, the Marcus Portable Booster Transformer has exceptionally high dielectric and thermal stability. It is wound with silicone enamel magnet wire and has twist-lock plugs for safe connections. Made in crinkle gray steel finish, one unit can handle two ¾ ton room air conditioners.

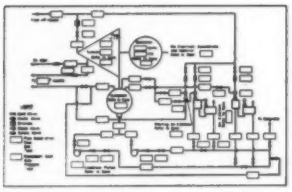
"Mark of Quality"

MTC

Representatives in Principal Cities

MARCUS
TRANSFORMER CO., Inc.
RAHWAY, NEW JERSEY

ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DRY TYPE TRANSFORMERS EXCLUSIVELY



Large Projects

—*Starts on page 28*

operating labor, but such intangible factors as depreciation and obsolescence must be considered to ensure economical equipment selection.

To determine a market price for his proposed product, the client had to assume a fair depreciation rate for the plant. This rate is largely determined by his previous experience and is based on the maximum period of time in which he might expect to sell his product at a figure calculated to return investment capital and to yield an equitable rate of return. Since, unlike the classic "one-horse shay" all equipment does not go to pieces all at one time, depreciation rates must be fixed which will represent a fair average life of the plant. The problem also is complicated by depreciation rates allowed by Federal and State Laws for tax purposes.

Another major consideration in determining depreciation rates is the obsolescence factor. In most basic industries such as mining, steel, power, paper, textiles, and lumber, methods and processes change rather slowly, and therefore useful life is the prime determinant. In such industries as chemicals and pharmaceuticals, however, technological advances are so frequent and swift that obsolescence must be the determining factor. In a number of instances, equipment has become obsolete in as few as two years. As an example, the deep vat process of manufacturing penicillin, which came on the heels of the bottle process used in the earlier days of World War II, caused many bottle-process plants to become obsolete even before they went into production.

Style changes in consumer products constitute another reason for high depreciation rates due to early obsolescence. These changes require frequent retooling and equipment rearrangement as demonstrated in the automotive and appliance fields.

Selection of equipment should therefore be made on the basis of close correlation with expected overall depreciation. For instance, it would not make sense to specify a pump with a life expectancy of thirty years for a process which is expected to be obsolete within five years, but the difference in cost would be a small price to pay for long life and low maintenance in a low obsolescence plant.

Construction

A large proportion of the client's total cost for the project — between 25 and 50 percent — lies in its construction. Here the engineering firm can play a role of major importance. Most of the cost of construction is established in the information conveyed in drawings and specifications provided the contractors, and the number of field changes is determined by the detail provided in these plans.

It is the responsibility of the project manager, in cooperation with the construction engineer, to prepare specifications for the purpose of letting a construction contract. Although there are many variations of construction contracts, most are based upon a lump sum, labor and material plus overhead and profit, or cost plus a fixed fee.

The decision as to the type of contract will depend largely on the state of completion of engineering specifications and drawings. Experience has shown that cost plus contracts generally exceed engineering estimates, in some instances by as much as 100 percent.

Since the lump sum contract requires completed drawings and specifications for letting, it frequently is not possible to negotiate such a contract. However, planning and coordination will usually result in the drawings being completed in time for lump sum bidding. A sign of more competitive times ahead is the rapidly increasing requests for such bidding from construction contractors. To the engineering firms which plan wisely and efficiently, this should be no real challenge. ▲▲

The Folded Plate

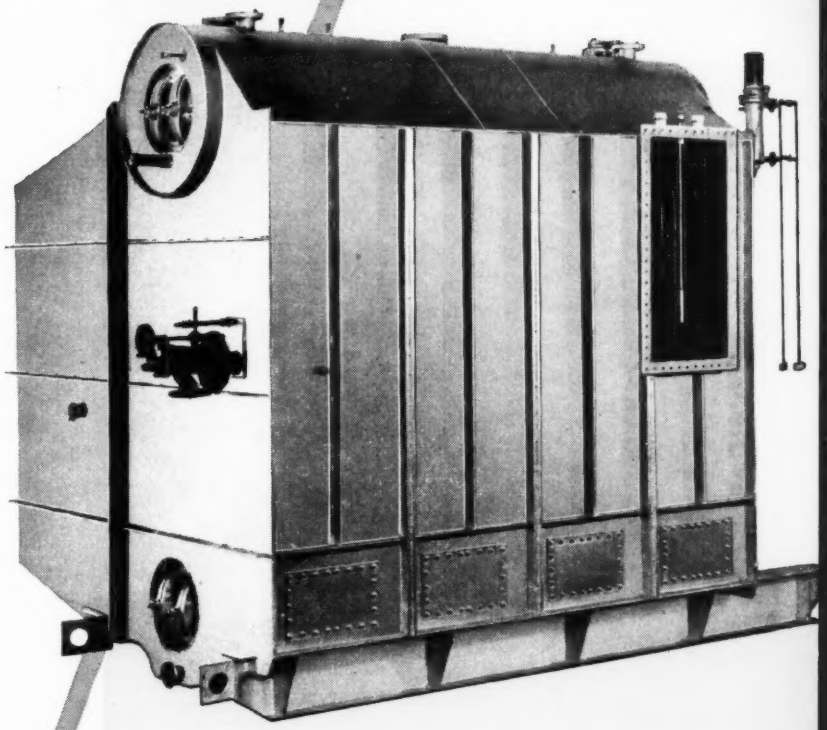
—*Starts on page 51*

would also form the foundation wall, and only a continuous strip footing with a groove to receive the wall would be required. The precast or cast-in-place columns usually required with tilt-up walls would be unnecessary because the roof would adequately brace the walls. If a dock-height warehouse is required, the tilt-up walls also serve as retaining walls of any height for the fill inside the building.

Cost estimates of this type of structure indicate that it would cost about the same as a conventional steel-framed building with a noncombustible roof and lightweight concrete block walls. The costs for the H. W. Moore building are not indicative of the economy of this type of construction since the building was monumental in character and featured several luxury items including radiant heating and cooling. The original bids for this building were about $9.00 per square foot of covered area, including the mezzanine floor.

Studies of large warehouse construction using 80-ft spans indicate a cost of about $3.60 per square foot, including very simple heating and lighting. For smaller spans, these costs can be reduced to a point where we believe they will be competitive with conventional designs now being used. ▲▲

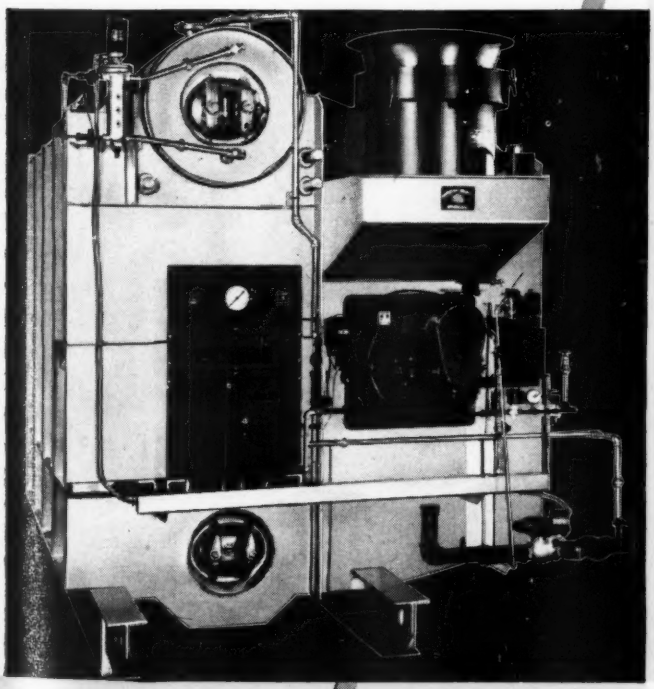
Ahead in Design!



QUICKER, EASIER INSTALLATION!

When you compare quotations for package boilers, check all of the *additional values* Springfield gives you! Make sure you are getting a COMPLETE UNIT ready to connect to fuel, water, electrical, and steam lines — with *no extras* required for setting and other materials.

Springfield Package Boilers are unique in that the basic design is actually the same as a large power plant boiler — consequently, they can be built for as high as 900 psig. operating pressure. These units are also excellent for generation of high pressure — high temperature hot water. *Send for complete information.*



SPRINGFIELD PACKAGE TYPE BOILERS

1. Rugged 2-Drum, Bent Tube *"Power Plant Type"* design. No headers, no handholes, no wasted weight. Unrestricted circulation.

2. Complete "6 wall" furnace cooling for greatest capacity. Permits higher heat release rates with lower actual "heat loading" of tubes.

3. Dry Steam — steaming tubes discharge above top drum water level.

4. Exclusive gas-tight, insulated, double-cased steel jacket. Sectional construction makes all tubes easily accessible and replaceable without necessity of tearing out and repairing side wall setting.

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Ethics

—Starts on page 32

employed to audit the books of all architects and engineers in each area and report all infringements of regulations to an elected board.

4. All reported cases would be judged by this board and appropriate disciplinary action imposed. Punishment might include a heavy fine plus revocation of the professional licenses of the principals.

5. A system of double check can be initiated by any firm suspecting the correctness of the official audit. They can call for outside auditors to recheck the books of any firm at any time but must bear the cost of such an audit if the books are found to be correct.

6. Firms unwilling to cooperate with such a plan will first be given very unfavorable publicity and, if shown to be collaborating with political grafters, will be brought to trial by the board in the criminal courts.

7. Grievance committees, which are presently almost non-functional, should be given an aggressive policy and rules with teeth in them.

Cooperative Action

Although this action is best taken on a national level, state and local efforts should certainly be encouraged. The cooperation of the engineering societies would greatly help the program. However, it is naive to expect that effective measures can be promulgated without considerable resistance. Overcoming this resistance will require a pioneering effort, further education and dissemination of information to the public and the profession, and a flexible program that will "give-and-take" to meet local requirements without compromising fundamental principles.

As an example of the type of obstacle that can be expected, more than one individual has suggested that I, personally, should turn over all evidence and information available to me to appropriate grievance committees. By this action, they say, the malpractice could be ended. This might be a sound procedure if the committee could take effective action against the violator. But under the existing set-up and operating rules, I am more inclined to believe that one man's word against another would be inconclusive, leading to no action but much embarrassment for all, and even worse the malpractice would continue!

There is no compromise, no half-way measures, to meet corruption. Take one of the most serious malpractices, that of "kickbacks", for example. Ten, twenty, thirty, or even higher percentages of the professional fees are kicked back in small bills to corrupt political figures through appropriately worked out channels or mechanisms.

"Bag men" are popular in the East, whereas enforced professional fees to cooperating unethical lawyers is common practice in certain sections of the Midwest. Some engineers rationalize by saying they will pay no graft but will pay by check a "commission" or "finder's fee".

Engineers who have allowed themselves to be captured by this kind of reasoning are not worthy of the name "professional". We are not fooling anyone, including ourselves, when we give a "commission" or "finder's fee" and take the position that no part of this "influence money" reaches corrupt politicians.

It is the opinion of a number of excellent accountants with whom I have discussed our problem, that properly set up books cannot cover up one-half of one percent of an engineering fee. Thus, "kickbacks", or other malpractices involving any substantial percentages or amounts, would clearly stand out.

It is a sobering thought when we realize we, as engineers, are in one way or another responsible for the annual expenditure of about 35 billion dollars. This is a public trust we cannot glibly brush aside as the responsibility of others. Those who answer the problem by simply ignoring it or by "letting George do it" are accepting the privileges but not the responsibilities of our profession.

Our ingenuity, courage, and creativeness in dealing with technical problems should serve us well in approaching the grave problem which we face. If we add two further factors, a successful solution is assured. These factors—unity and inspired wisdom—are, in fact, the forgotten key to world peace. Quoting Benjamin Franklin's historic statement which brought unity out of division and wisdom out of frustration for our Constitutional Convention: "I have lived, Sir, a long time, and the longer I live the more convincing proofs I see of this Truth—that God governs in the Affairs of Men!—And if a sparrow cannot fall to the ground without His notice, is it probable that an Empire can rise without His Aid? We have been assured, Sir, in the sacred writings that 'except the Lord build the House, they labor in vain that build it!' " ▲▲

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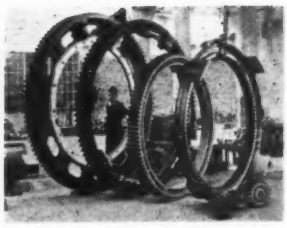

Ductile Iron

—*Starts on page 46*

cations are that this material is excellent for such usage because it has the high wear resistance of cast iron. It will, in other words, give much longer wear life than cast steel.

This property of good wearability is particularly useful in such products as gears, gear racks, and bearings. It has replaced gray iron, cast steel, and bronze in a number of applications. The ease with which it can be cast and machined makes it more attractive than steel where its strength is sufficient, and it greatly outwears bronze under conditions involving heavy loads. It has been found to outwear bronze four or five times when used as a bearing for heavy loads such as are encountered in steel mill rolls. Its advantage over cast iron is its resistance to shock and the higher strength.

Very light sectioned castings can also be made in ductile iron. Large production runs of castings, weighing as little as ⅓ oz, have been made by the Ductile Iron Foundry Company, Stratford, Connecticut. Most of the light castings are annealed to give maximum ductility, toughness, and machinability, but castings with over ½ in. minimum section can be turned out in the as-cast condition.

Some extremely heavy gears have been cast in ductile iron in Italy. Dr. Corrado Galletto reported on the methods used in a paper presented before the American Foundrymen's Society in 1952. Huge crown wheels as much as 12-ft in diameter and weighing as much as 9900 lbs have been cast in pits. Dr. Galletto reported that machinability has always been good in the as-cast condition—as good as high-strength gray iron despite the higher hardness of the ductile iron casting.

Additional Uses

Recently, a new application has been found for ductile iron. It has been discovered that it has excellent resistance to moderately elevated temperatures. In 1951, the Canadian Furnace Company, Ltd. conducted service tests on grate sections for a Greenawalt sintering furnace. Gray iron bars had to be replaced every six weeks while the ductile iron bars were still in service after 10 months of operation. The same type of results were reported for grates for a marine boiler in service on the Great Lakes. Good results have also been had with ductile iron furnace doors for heat treating furnaces. A life of 17 weeks was reported in one installation against a life of 4 weeks for gray iron. Apparently the shape and distribution of the graphite retards destructive growth resulting from penetration of oxidation. This penetration is much greater in gray iron than in ductile iron.

As the production of ductile iron increases, additional worthy applications will no doubt be discovered, and the consulting engineers' increased familiarity with the material will mean that it will appear more and more often in specifications involving ferrous castings. In 1949, only 2500 melt tons were processed in the United States and Canada. This increased to somewhere between 15,000 and 20,000 melt tons in 1950. In 1953, this figure had been increased considerably. Consulting engineers will readily recognize the many applications for a material with the characteristics possessed by ductile iron. It deserves a more detailed study by the men who write the specifications. ▲▲

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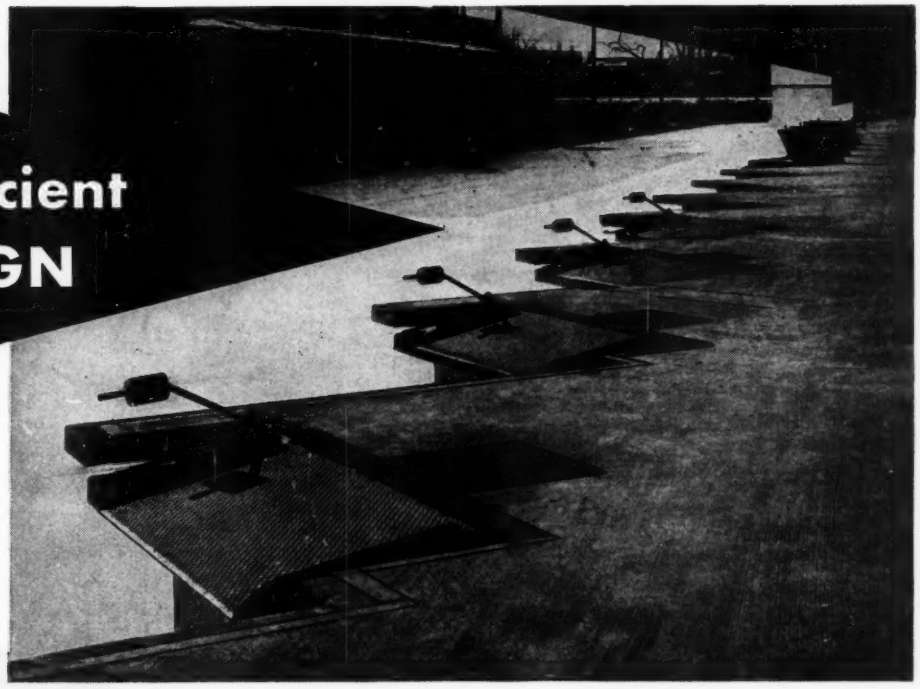

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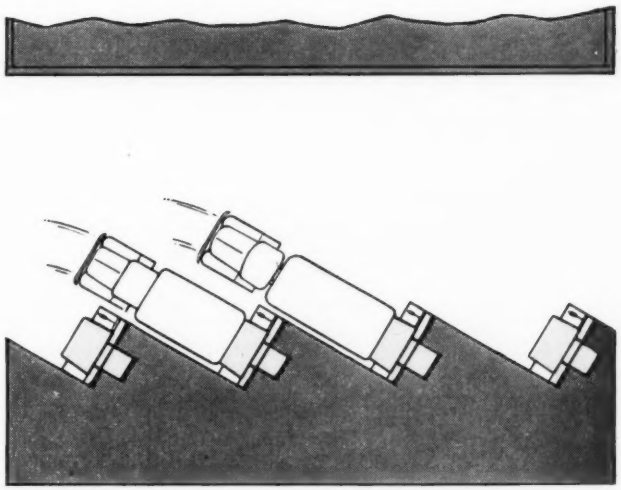

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Coal Microscopy

—*Starts on page 38*

of a coal. With low rank coals, similar tissues of different plants may differ chemically even though a part of the same coal. Hence, knowledge of the kind of plants that contributed to a coal can be of direct importance in utilization of low rank coals.

Petrographic Components of Coal

Although the composition of coal as seen under the microscope is very heterogeneous, coal microscopists have long realized that the different kinds of structures can be grouped in a relatively limited number of components. Although organic, coal is a sedimentary rock in a broad sense. The structural components of coal can be thought of as analogous in a general way to the minerals of which ordinary rocks are made. Petrography is the systematic study of rocks. The structural components of coal, therefore, are called petrographic components, although they are not really minerals but broad classes of different sorts of plant tissues that have been altered during and after deposition.

TABLE 2—COMPARATIVE PETROGRAPHIC ANALYSES BY THE AMERICAN AND GERMAN METHODS (A) ON COAL FROM HAGEN BED, BRASSERT MINE, GERMANY

American Technique Composition in Percent		*German Technique Composition in Percent*	
Anthraxylon	43	***Vitrit***	42
Translucent attritus	40	***Clarit***	38
Opaque attritus	15	***Durit*** and ***Semifusinit (B)***	14
Fusain	2	***Fusinit***	6

A. Modified from Table 32, Kuhlwein and Hoffmann[1].

B. ***Semifusinit*** is an intermediate between ***Vitrit*** and ***Fusinit***.

There has been much dispute about systems of nomenclature for the petrographic constituents, and very different names have been used by different coal scientists. (The system of nomenclature most commonly used in this country was developed by the late R. Thiessen, of the U. S. Bureau of Mines.) Authorities agree, however, that there are four principal constituents, each of which is on the order of a family, with many members or subdivisions. These constituents are listed in Table 1, comparing the terms used by the U. S. Bureau of Mines and by German coal petrographers. Microscopists in other countries and some U. S. scientists use somewhat different systems, but of a similar over-all pattern.

These basic petrographic components of coal have

TABLE 3 — SOME CHARACTERISTICS OF PETROGRAPHIC COMPONENTS OF GERMAN BITUMINOUS COALS (A)

Petrographic Component	*Vitrit*	*Clarit*	*Durit*	*Fusinit*
Nearest equivalent (B)	Anthraxylon	Translucent attritus	Opaque attritus	Fusain
Volatile matter	Normal(C)	If rich in waxy matter, somewhat above normal	If rich in waxy matter, much above normal; if rich in completely opaque matter, somewhat lower	Minimal
Hydrocarbon content (tar yield)	Normal(C)	If rich in waxy matter, somewhat above normal	If rich in waxy matter, much above normal; if rich in completely opaque matter, somewhat lower	Minimal
Carbonization residue	Normal(C)	Somewhat below normal	Variable	Much above normal
Ash content, percent	0.5 or less to 1.0	0.5 to 2.0	1.0 to 5.0 and higher	Soft fusain below 5.0, hard fusain above 5.0
Coking characteristics	Best coal for coking if 19-28% volatile matter; 16-18% and 29-35% blendable; otherwise poor	Best coal for coking if 19-28% volatile matter; 16-18% and 29-35% blendable; otherwise poor	Variable according to coalification and microstructure, from blendable to inert	Inert
Specific gravity	About 1.3	About 1.3	1.25 to 1.45	1.4 to 1.6
Electrostatic property: Surface conductivity	Conductivity least if volatile matter is 12-32%; otherwise higher	Somewhat higher than anthraxylon	Substantially higher than anthraxylon	Much higher than anthraxylon
Strength characteristics	Brittle or readily decomposing by cracking	Between anthraxylon and opaque attritus	Compact to tough; coarse	Friable (soft fusain) or hard (hard fusain—high in mineral matter)

A. Modified from parts of Tables 54 and 86, Kuhlwein and Hoffmann.[1]

B. See Table 1.

C. Normal: Average for whole coal.

TABLE 4 — PROXIMATE AND ULTIMATE ANALYSES OF ISOLATED PETROGRAPHIC COMPONENTS AND RAW WHOLE COAL FROM TWO BEDS IN THE RUHR DISTRICT OF GERMANY (A). (PRESUMABLY ON AS-RECEIVED BASIS.)

Petrographic Components	Proximate Analysis, Percent		Ultimate Analysis, Percent		
	V. M.	Ash	C	H	O
Hagen Bed					
Vitrit-Clarit. (Predominantly anthraxylon plus translucent attritus.)	42.6	1.3	77.4	5.30	13.5
Durit. (Composed mostly of opaque attritus — see Table 1.)	44.8	2.0	79.7	5.20	10.9
Bed as a whole (B).	45.5	6.9	74.3	5.34	13.6
Bismarck Bed					
Vitrit-Clarit. (Predominantly anthraxylon plus translucent attritus.)	35.0	5.0	79.35	5.20	10.6
Durit. (Composed mostly of opaque attritus — see Table 1.)	37.0	2.0	80.00	5.46	7.7
Bed as a whole (B).	37.0	5.0	78.30	5.36	10.2

A. Modified from Tables 58a and 58b, Kuhlwein and Hoffmann.[1]

B. Apparently average analyses for the beds rather than analyses of same samples from which petrographic components were taken.

TABLE 5 — PROXIMATE AND ULTIMATE ANALYSES OF PETROGRAPHIC COMPONENTS OF FOUR AMERICAN BITUMINOUS COALS — TWO FROM WEST VIRGINIA AND ONE EACH FROM PENNSYLVANIA AND ALABAMA (A)

Coal Constituent	Proximate Analysis, Percent				Ultimate Analysis, Percent					Thermal Value
	Moisture	Ash	V. M.	F. C.	H	C	N	O	S	Btu per lb
	As Received		← Moisture and Ash Free Basis →							
Composite values for whole coal from all four beds	2.1	7.0	36.9	63.1	5.6	85.2	1.7	6.4	1.1	15,200
Average value for pure anthraxylon (four samples)	1.4	1.8	34.3	65.7	5.5	85.6	1.7	6.4	0.8	15,208
Average value for spore-rich attritus (three samples)	1.1	3.8	41.5	58.5	5.8	85.5	1.6	6.5	0.6	15,407
Pure opaque attritus (one sample)	1.2	9.1	24.7	75.3	4.5	87.5	1.4	6.2	0.4	14,980
Average value for fusain (two samples)	1.0	6.4	18.9	81.1	3.8	89.5	0.7	5.5	0.5	14,955

A. Modified from Table 1, Sprunk and Thiessen.[2]

gross features that can even be detected with the naked eye. Anthraxylon or *Vitrit,* for example, has a bright, lustrous appearance to the naked eye when it occurs in bituminous coal and a woody appearance (sometimes even resilience) when it occurs in lignite and subbituminous coal. Fusain is usually fibrous and soft and makes a black smudge when rubbed between the fingers. Quantities of it make a coal very dirty.

The similarity of principal constituents in the Bureau of Mines and German systems is indicated in Table 2, which presents analyses of the same coal bed by R. Thiessen, originator of the Bureau of Mines nomenclature, and by two German scientists, F. Kuhlwein and E. Hoffmann. Except for the fact that some of what Kuhlwein and Hoffmann called *Fusinit* (fusain) was evidently classified otherwise by Thiessen, these analyses are nearly identical. Note, however, that such very close agreement could not always be expected, because *Clarit* can include small particles of anthraxylon *(Vitrit)* and other material that would be excluded from translucent attritus in an American analysis. Similarly, *Durit,* although predominantly opaque, often includes some translucent matter; opaque attritus includes no translucent matter. Hence, opaque attritus and *Durit* are similar but not equivalent.

Once the distinctness of the petrographic components is established, what relationship is there between these components and the properties of coal as found in practice? Table 3 presents some of the physical and chemical characteristics of these components as found in German bituminous coals, while Table 4 lists the comparative chemical analyses of petrographic components of two German bituminous coal beds. Similarly, the differences between petrographic components in American coals are shown in Table 5.

Examination of these data indicates that the petrographic components differ from each other in more ways than merely appearance under the microscope. It is this fact that has been responsible for the development of coal microscopy, especially in Germany where microscopic investigations have played an important part in industrial coal research.

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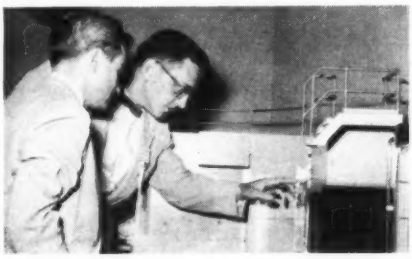

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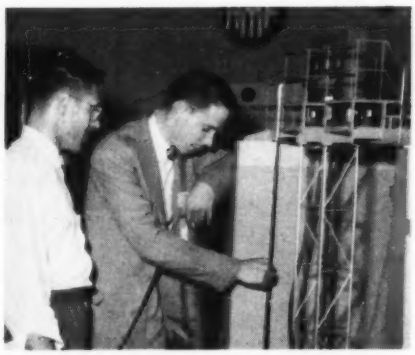
Over 1300 persons flocked to the week-long meeting on the Ann Arbor campus of the University of Michigan. Despite the uncomfortably warm weather, the sessions and exhibits were well attended.

The Hon. W. Sterling Cole, chairman of the Joint Congressional Committee, pin-pointed the undercurrent from which flowed the life of the sessions: "It is inevitable that reasonable men will differ in their recommendations...."



LEONARD J. KOCH, REACTOR ENGINEER, ARGONNE NAT. LABS.; HUGH C. NEALE, GENERAL ENGINEERING LAB, AMERICAN MACHINE AND FOUNDRY COMPANY.

And a sobering note came from John J. Grebe of Dow Chemical's Nuclear department: Much of the ballyhoo about nuclear energy as a means of power should be overlooked. Nuclear energy is not as big a thing as the invention of the wheel, but is on a par with the distribution of electricity pioneered by Edison and Tesla. Grebe's prognosis is that "before many years we will supplant the large central power stations with small, economic, self-sustained atomic sub-stations. (Since) power transmission is as costly as is its production... producing power closer to the consumer... should (make available) energy for air conditioning, heating, freezing, industrial use, and many other employments of heat energy at a greatly reduced cost in the local sub-station area."

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A restrained attitude was reflected in the statement of Theodore Stern, Foster Wheeler, to the effect that nuclear power plants will not revolutionize the electric power industry; as different nuclear plants become economical for specific applications, they will be built to fit into our power systems without displacing existing facilities.

And it was Titus LeClair of Chicago's Commonwealth Edison who specifically sees that "Power companies who are considering the building of nuclear power plants will only have a real feeling of confidence to proceed after the first full scale plant has been built and opened for inspection."

consulting engineers' calendar

Date	Sponsor	Event	Location
July 13-15	Western Plant Maintenance Show	Conference and Exposition	Pan Pacific Bldg. Los Angeles, Calif.
Aug. 25-27	Western Electronics Show	Convention and Exposition	Los Angeles, Calif.
Sept. 8-10	American Society of Mechanical Engineers	Fall Meeting	Hotel Schroeder Milwaukee, Wisc.
Sept. 12-16	American Institute of Chemical Engineers	Fall Meeting	Colorado Hotel Glenwood Springs, Colo.
Sept. 12-16	Illuminating Engineering Society	National Technical Conf.	Chalfonte-Haddon Atlantic City, N. J.
Sept. 15-17	Compressed Air and Gas Institute	Meeting	Skytop Lodge Skytop, Pa.
Sept. 15-20	Instrument Society of America	International Instrument Exp.	Convention Hall Philadelphia, Pa.
Sept. 21-23	Society for Experimental Stress Analysis	Annual Meeting	Bellevue-Stratford Philadelphia, Pa.
Sept. 27-29	American Institute of Electrical Engineers	Petroleum Conference	Mayo Hotel Tulsa, Okla.
Sept. 28-Oct. 1	Association of Iron and Steel Engineers	Exposition	Public Auditorium Cleveland, Ohio
Oct. 4-6	National Electronics Conference	10th Annual Conference	Hotel Sherman Chicago, Ill.
Oct. 5-7	American Institute of Electrical Engineers	Middle Eastern Dist.	Abraham Lincoln Reading, Pa.
Oct. 6-8	MTM Association for Standards and Research	Annual International Conference	Hotel Statler New York, N.Y.
Oct. 11-15	American Institute of Electrical Engineers	Fall General Meeting	Conrad Hilton Hotel Chicago, Ill.
Oct. 18-22	American Society of Civil Engineers	Convention	Hotel Statler New York, N. Y.
Oct. 25-27	American Institute of Electrical Engineers	Machine Tool Conference	Hotel Statler Detroit, Mich.
Nov. 10-12	Industrial Management Society	Management Clinic	Hotel Sherman Chicago, Ill.
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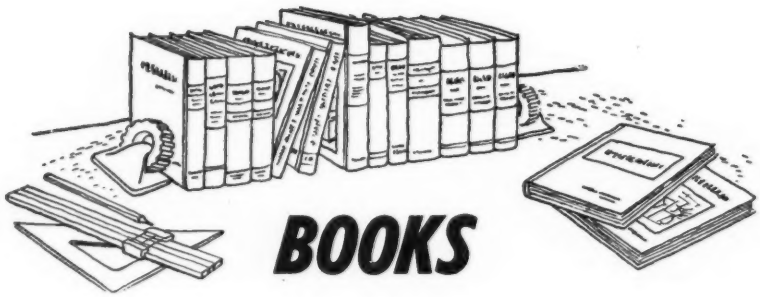

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COPPER. THE SCIENCE AND TECHNOLOGY OF THE METAL, ITS ALLOYS AND COMPOUNDS. Edited by Allison Butts; Reinhold Publishing Corp.; 936 pages; 1954; $20.00.

Reviewed by Scott Turner, Consulting Mining Engineer.

This is one of the American Chemical Society Monograph Series; it contains forty-six chapters, each by one or more specialists, many of whom are well-known in the copper industry.

The first of the monographs in this series appeared in 1921, as the result of the Interallied Conference of Pure and Applied Chemistry which met in London and Brussels in July, 1919, one of the results of which was that the American Chemical Society undertook the production and publication of scientific and technologic monographs on technical subjects; trustees were named by the Society to handle this assignment, and its Council appointed editors, to select authors of competent authority, and to scrutinize the manuscripts submitted for publication.

In this case, the result is a monumental volume, an epitome of valuable information regarding copper, a reference work on all important phases of this metal. Starting with a chapter covering the background of the copper industry followed by a description of copper minerals, ore and ore deposits, it covers beneficiation of the ores, smelting, and refining. The text then deals with special aspects of the chemistry and metallurgy of the metal, its alloys and isotropes, and describes the place of copper in various industries, including agriculture.

To summarize, about a third of the volume is devoted to descriptions of the occurrence and extractive metallurgy of copper, a considerable part to its physical and mechanical metallurgy, perhaps a fifth of the text describes the properties and applications of the metal and its alloys, and a quarter of the book deals with special aspects of the chemistry and physics of copper.

Those chemists, metallurgists, and engineers who have to deal with copper, or make it their principal business, will either want to have a copy of this comprehensive treatise on a shelf of their libraries, or will need to know where one can be found in a near-by reference library.

FIXED END MOMENTS by Paul Rogers; Frederick Ungar Publishing Co.; 95 pages; $3.75

Reviewed by Martin P. Korn Consulting Engineer

We have here a compact manual of tables and formulas for fixed end moments, covering a very wide field of loading conditions. Each condition is presented separately with a loading diagram, tables for fixed end moment coefficients, mathematical formulas and charts for those who prefer them.

The formulas can be found in other publications but—so far as this reviewer knows—this is the first time that fixed end moments for unusual loading conditions have been given from both ends with tables, etc. Your computations are thus accelerated and the chance for error is minimized by not having to reverse your loading diagram.

For any design office using moment distribution—and I know of none that do not—this book will pay for itself in time and work saved the very first time it is used. The tables look out at you boldly. You don't have to squint to see them. They perform as a new design tool you

would warm up to quickly. Good publishing.

APPLIED ELECTRONICS, Second Edition, by Truman S. Gray; John Wiley & Sons, Inc.; 1954; $9.00.

Reviewed by A. A. Gerlach
Cook Research Laboratories

A second edition, the earlier version having been printed in 1943, this book is one of the "Principles of Electrical Engineering Series" originated at the Massachusetts Institute of Technology.

The book is directed toward third and fourth year students who are following a formal course in Electrical Engineering. The theme of the book is on the fundamentals which govern the characteristics and behavior of this broad field of electronics. The coverage of the book is certainly an ambitious one for any author. The early part of the book is devoted to the derivation of quantitative relationships in electron ballistics; thermionic, secondary, and photo-electric emission; and electrical conduction in gases, vapors and vacuum. The author then considers various vacuum and gas tube geometries and derives their various characteristics and coefficients. The next several chapters (amounting to about two-thirds of the text) is devoted to applications of gas and vacuum tubes as circuit elements in such applications as rectifier circuits, linear and non-linear amplifiers, oscillators, and modulation and detector circuits. A final chapter is devoted to semi-conductors and their relation to the vacuum tube.

The format of the second edition is essentially the same as the first edition; however, the author has expanded on the contents of the old edition to keep pace with ever expanding applications and techniques. In addition to the general expanded coverage the chapter on semiconductors as non-linear and control elements is new.

A book which presumes to cover the scope of applied electronics is bound to be subject to some criticism; however, the book is certainly a welcome one in the general field of electronics and Dr. Gray has done an excellent job of organizing and presenting the material contained therein. Many will welcome the fact that no particular advanced mathematics is required in reading the text, and at the same time there is no lack of fundamental logic and rigor of thought. Dr. Gray's style of reasoning and presentation reflects many years of teaching experience, and he has been welcomely consistant in his use of symbols. The book is adequately illustrated with easy to understand drawings and graphs.

In addition to being an excellent and versatile textbook for the classroom the book is also recommended as a reference manual for the practicing engineer's bookshelf. Its utility as a reference is primarily derived from the fundamental concepts contained in the early chapters and the fact that the scope of the book is broad. This being the case, the practicing engineer may use the book to "brush-up" on fundamental quantitative relations, and to seek more extensive reading from the bibliography contained in the book.

ALSO AVAILABLE

NFPA HANDBOOK OF FIRE PROTECTION, 11th Edition, Edited by Robert S. Moulton; National Fire Protection Association; 1656 pages; $10.50. This 11th addition of the NFPA Handbook presents the essential information on fire prevention and protection that time has crystallized into good practice. The Handbook is the only reference volume of its kind available today, and it represents two-year's work on the part of the National Fire Protection Association staff with the assistance of a number of expert consultants. The Handbook should be useful to the experienced fire protection engineer, architects, inspectors, and industrial management who are anxious to secure the latest fire protection engineering information.

Automatic spray sprinklers, developed since the last edition was published, are fully described and illustrated. New dry pipe valves, water flow alarms, and other automatic sprinkler devices are illustrated with diagrams showing construction and method of operation. The chapter on Water Spray, completely rewritten, contains tables of discharge characteristics of each brand and model of spray (fog) nozzle.

The tables of flammable liquids and hazardous chemicals have been revised to include new chemicals as additional data has become available during the past five years.

Tables of automatic sprinkler performance in actual fires and of the causes of fires by occupancy classification, based on an analysis of over 50,000 fires, have been revised to present an up-to-date statistical background for fire prevention measures.

NEMA STANDARDS FOR POWER CIRCUIT BREAKERS, Publication No. SG4-1954; National Electrical Manufacturers Association; $5.00. Rating, manufacturing, testing, and application are covered in this new edition of the NEMA Standard for Power Circuit Breakers. The testing standards have been considerably expanded in this edition and cover both design and routine tests. The book also contains information concerning the installation, operation, and care of power circuit breakers, and the terms used throughout the publication are defined.

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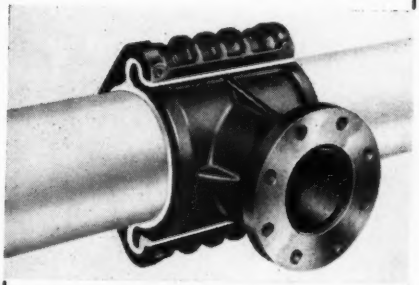

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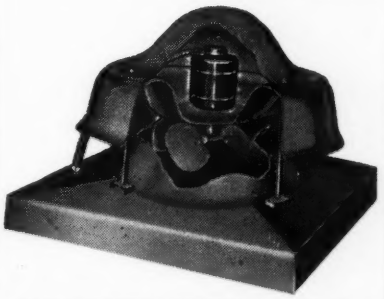

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